INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

ANNUAL REPORT
1989

10 Burlington Road, Dublin 4

Pl.7987

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

Annual Report of the work of the Institute and its Constituent Schools presented by the Council to the Minister for Education in respect of the year ended 31 December 1989

Pl.7987

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

Summary of Annual Report
of the work of the Constituent Schools
for the year ended 31 December 1989

School of Celtic Studies

In accord with its primary obligation to investigate and publish extant manuscript material in the Irish language, the School of Celtic Studies continued its programme of manuscript cataloguing under the direction of Dr Pádraig de Brún. One catalogue was published, and good progress was made on four other projects.

In the editing of manuscript literature, the most substantial achievement during the year was the completion of K. H. Jackson's edition of Aislinge Meic Con Glinne, which was prepared for publication by Dr Pádraig Ó Macháin. Work continued on the School's Early Irish Law Series under the direction of Dr Fergus Kelly.

East Perthshire Gaelic by M. Ó Murchú was the main contribution to spoken language studies.

In the development of Irish and Celtic Studies, momentum was maintained in the School's Bibliography of Irish Linguistics and Literature 1972 - under the supervision of Rolf Baumgarten, and other bibliographical projects were planned.

Staff and scholars worked on and published a variety of individual projects; the School organised a respectable programme of lectures and seminars on aspects of Irish and Celtic Studies; facilities were provided for many visiting scholars.

School of Theoretical Physics

Thirty-eight research workers from the universities or other institutes of research or higher education (mainly in Ireland) were admitted as Research Associates of the School; thirty-seven scientists from abroad visited the School during the year.

Mathematical symposia were held at Easter and at Christmas; twenty-seven seminars were held at DIAS and joint seminars with other third level institutions took place. Members of the School gave five lectures in Ireland. The statutory public lecture was given at UCD by Dr John S. Bell, FRS.

The primary areas of research were theoretical particle physics and statistical mechanics, members of the School published two books and sixty-one papers in scientific journals and conference proceedings; they participated in twenty-eight conferences abroad.

School of Cosmic Physics

The School of Cosmic Physics is concerned with that branch of Physics which investigates the order and structure of the universe around us. Currently there are three sections; the Astronomy section based in Dunsink Observatory, and the Cosmic Ray and Geophysics sections both based in 5 Merrion Square.

As well as carrying out its own programmes of observations on Ap and symbiotic stars and theoretical studies in cosmology and statistics the Astronomy section continued to provide modern facilities for optical observations to other Irish astronomers through the La Palma Observatory in the Canaries. The tenth anniversary of the agreement allowing access to the La Palma telescopes was celebrated during the year with a small exhibition. The feasibility of using real time 'image sharpening' techniques in La Palma was investigated in collaboration with UCG and other groups.

The successful arrival of the Phobos-2 spacecraft at Mars, and the several weeks of measurements of particle fluxes in the Martian environment by the SLED experiment which followed, were a good start to the year for the Cosmic Ray section. Analysis and theoretical interpretation of the results previously obtained from the EPA experiment on the Giotto mission to comet Halley continued as did preparations for the anticipated retrieval of the LDEF spacecraft in 1990. A proposal for a large cosmic ray experiment named ELISA was prepared in collaboration with thirteen European research centres and submitted to the European Space Agency. Work on phenomena associated with star formation continued and formed the basis of proposals for observations with the Hubble Space Telescope and the Infrared Space Observatory. Theoretical studies of particle acceleration processes continued as did an investigation into the elemental abundancies in the Magellanic clouds.

Seismic studies dominated the work of the Geophysics section with the first analysis of the data from the RAPIDS survey of the Rockall Trough being particularly noteworthy both for its intrinsic scientific interest and its potential economic and political implications. Analysis of data from the North Celtic Sea Basin continued and the section participated in a European Geotraverse seismic project in the Iberian peninsular. Preparations were made for a seismic survey in the Kenyan rift valley and closer to home an experiment was carried out to detect reflections from the base of the crust of S-waves generated by quarry blasting at Slane and Huntsdown. Preparation of the gravity survey maps continued as did palaeomagnetic studies and some meteorological observations.

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH

(Dublin Institute for Advanced Studies)

Annual Report of the work of the Institute
and its Constituent Schools presented by
the Council for the year ended
31 December 1989

In accordance with the provisions of Section 29 of the Institute for Advanced Studies Act, 1940 (No. 13 of 1940), the Council of the Institute has the honour to present to the Minister for Education for submission to the Government a report of the work and activities of the Institute and its Constituent Schools for the year ended 31 December 1989.

The report is presented under the following principal heads:-

I Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31 December 1989.

II Report of the Governing Board of the School of Celtic Studies.

III Report of the Governing Board of the School of Theoretical Physics.

IV Report of the Governing Board of the School of Cosmic Physics.

1 Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31 December 1989.

1. THE COUNCIL OF THE INSTITUTE

Chairman

T.K. Whitaker, D.Econ.Sc.

Ex-Officio Members

Patrick Masterson, M.A., Ph.D., President, University College, Dublin; W.A.Watts, M.A., Sc.D., Provost, Trinity College, Dublin; J.C.I. Dooge, M.E., M.Sc., C.Eng., F.I.E.I., F.A.S.C.E., D.Agr.Sc., President, Royal Irish Academy.

Members appointed by the Governing Boards of Constituent Schools

M. Ó Murchú, M.A., Ph.D.; T. de Bhaldraithe, M.A., Ph.D., D.Litt.; J.T. Lewis, B.Sc., Ph.D.; A.J. McConnell, M.A., M.Sc., Sc.D., F.T.C.S.; P.A. Wayman, Ph.D.; E.F. Fahy, M.Sc., Ph.D.

2. GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES

Chairman

T. de Bhaldraithe, M.A., Ph.D., D.Litt.

Senior Professors

M. Ó Murchú, M.A., Ph.D.; P. Mac Cana, M.A., Ph.D.

Appointed Members

G. Mac Eoin, M.A., Ph.D.; S. Mac Mathúna, B.A., Ph.D. (Q.U.B.); M.P. Ní Chatháin, M.A., Ph.D. (Edin.); S. Ó Coileáin, M.A., Ph.D. (Harv.); P. Ó Fiannachta, M.A.; T. Ó Floinn, M.A.; S. Ó Tuama, M.A., PhD.; G. Stockman, M.A., Ph.D., Dip.Ed.; G. Victory, B.A., Mus.D.; T.K. Whitaker, D.Econ.Sc.

3. GOVERNING BOARD OF THE SCHOOL OF THEORETICAL PHYSICS

Chairman

A.J. McConnell, M.A., M.Sc., Sc.D., F.T.C.D.

Senior Professors

J.T. Lewis, B.Sc., Ph.D; L. Ó Raifeartaigh, M.Sc., Ph.D.

Appointed Members

J.C.I. Dooge, M.E., M.Sc., C.Eng., F.I.E.I., F.A.S.C.E., D.Agr.Sc.; J.N. Flavin, M.Sc., Ph.D.; M.A. Hayes, M.Sc., Ph.D.; P. Quinlan, B.E., D.Sc., Ph.D.; T.D. Spearman, M.A., Ph.D. (Cantab.), F.T.C.D.; S.S. Tóibín, M.Sc., Ph.D.

4. GOVERNING BOARD OF THE SCHOOL OF COSMIC PHYSICS

Chairman

E.F. Fahy, M.Sc., Ph.D.

Senior Professors

P.A. Wayman, Ph.D.; L. O'C. Drury, B.A., Ph.D.

Appointed Members

A. Brock, M.A., Ph.D., F.R.A.S., F.Inst.P.; D.J. Bradley, Ph.D., F.R.S., F.T.C.S.; P.K. Carroll, M.Sc., Ph.D.; M. de Groot, Ph.D.; G.F. Imbusch, Ph.D., D.Sc.; D.J. Murphy, B.Sc., M.Sc.; V.J. McBrierty, B.Sc., M.A., Ph.D. (Lond.) Sc.D., C.Phys., F.Inst.P., F.T.C.D.; N.A. Porter, Ph.D.; D.L. Weaire, B.A. (Cantab.), Ph.D. (Cantab.).

5. ADMINISTRATIVE STAFF

Registrar

John Duggan

Senior Clerk

Maura Devoy, B.A.

Accounts Clerk

Mary A. O'Rourke, B.A.

Clerks

Angela Stubbs; Noreen Granahan; Caitríona Tubridy (on career break); Desmond Pender; Eibhlín Nic Dhonncha.

EQUALITY OF OPPORTUNITY

Council of the Dublin Institute for Advanced Studies at its meeting of 31 May 1988 formally adopted the Government's Policy Statement on Equality of Opportunity between men and women on the staff of the Institute.

The Council of the Institute, recognising the importance of promoting equal opportunity, appointed its Chief Executive Officer as Employment Equality Officer (EEO) with responsibility for staff development. The EEO participates in the newly formed networks of EEO's in Semi-State bodies.

The Council supports equality of opportunity in recruitment and any vacancy advertised is open to everyone qualified irrespective of sex, race or marital status, except where otherwise stated and where so otherwise stated shall be strictly in accordance with the Employment Equality Act 1977. No candidate will be discriminated against on account of physical handicap or disablement, provided that she/he can perform the job satisfactorily. Subject to Public Service practice, no discriminatory age limits will apply, but the interview board will take into account ability of candidates to give effective service on appointment.

The following measures designed to promote equal opportunities have been adopted by Council of the Institute:

1. Introduction of flexible working arrangements.

2. Operation of a career break facility. Three members of staff have availed of career breaks.

3. Setting up of a joint management negotiating committee; any difficulties arising from operation of the Equal Opportunity programme may be referred to this committee.

The Institute's staff complement is 33 male and 25 female. One disabled person is employed.

II Annual report of the Governing Board of the School of Celtic Studies for the year ending 31 December 1989, adopted at its meeting on 6 September 1990

1. STAFF AND SCHOLARS

Professors Emeriti:

D. A. Binchy (died 4 May), James Carney (died 7 July), Brian Ó Cuív.

Senior Professors:

Máirtín Ó Murchú (Director), Proinsias Mac Cana.

Assistant Professors:

Pádraig de Brún, Fergus Kelly, Rolf Baumgarten, Mícheál Ó Siadhail (career break from 1 October 1987).

Research Assistant:

Malachy McKenna

Assistant (part-time):

Nessa Doran

Librarian Executive:

1 Vacant

Secretary/Publications Officer:

Máire Uí Chinnseala

Clerical Staff:

1 Vacant

Temporary Library and Bibliographical Personnel (by arrangement with FÁS)

Teresa Costelloe (to 31 March), Thomas Kearns (to 31 July), Brendan Teeling (to 30 June); Lorcán Mac Meanmain (appointed 2 October).

Scholars:

Colin Ireland, Jürgen Uhlich (to 30 September); Aidan Breen, Kaarina Hollo, Ursula Marmé, Pádraig Ó Macháin, Seán Ua Súilleabháin; Joseph Eska, Karen Maund (from 1 October).

Research Associates:

Dr Michael Lapidge, Cambridge University; Dr Cathair Ó Dochartaigh, Bangor, Wales; Dr Richard Sharpe, Oxford University; Dr David Dumville, Cambridge University; Professor William Gillies, Edinburgh University; Professor Eric P. Hamp, Chicago University; Dr Máirtín Mac Conmara, MSC, Dublin; Professor T. Arwyn Watkins, Swansea; Professor Geraint Gruffydd, Centre for Advanced Walsh and Celtic Studies, Aberystwyth; Donald MacAulay, Aberdeen University.

Visiting Research Associate:

Dr Mark Scowcroft, University of Virginia (July - September).

2. RESEARCH AND EDITING

Professor Brian Ó Cuív continued work on various linguistic, literary and historical aspects of the Irish language and completed (i) the chapter on 'Irish language and literature - 1845-1921' for Volume VI of A New History of Ireland, (ii) an article on 'Dinnshenchas - the literary exploitation of Irish place names' for publication in Ainm Volume IV and (iii) the first draft of 'St. Gregory and St. Dunstan in a Middle Irish poem on the origins of liturgical change' for inclusion in a volume on 'St Dunstan and his times' to be published by Boydell and Brewer, Suffolk; he also read and corrected proofs of his article on 'Vowel hiatus in Early Modern Irish verse' which is to be published in the Eric Hamp Festschrift. See also §§ 7, 9.

Professor Máirtín Ó Murchú worked on dialects of W. Perthshire. A chapter on Modern Irish was accepted for publication in The Celtic Languages (ed. M. Ball). See also §§ 7, 9.

Professor Proinsias Mac Cana worked on (i) a number of topics in Welsh and Irish syntax, (ii) an edition of Fled Bricrenn and (iii) on the Old Irish Immacallam in dá Thuarad. The following articles were accepted for publication: 'Constituent order in Welsh' (in a volume on Constituent order in British and Welsh, ed. Erich Poppe et al.); updating of Myles Dillon's article on 'Celtic Religion' in the Encyclopedia Britannica. See also §§ 7, 9.

Dr Pádraig de Brún worked on (i) catalogue of Irish manuscripts in Trinity College, Dublin (with A. Nic Dhonnchadha); (ii) annotation of a list of Irish Society's Bible teachers; (iii) supervision and editing of catalogues of Irish manuscripts (National Library of Ireland; University College, Cork; Madison-Wisconsin, Harvard); (iv) copy-editing of electronic version of P. Russell Celtic word-formation. An article entitled 'Marbhna Éamainn Síonán' was accepted for publication in Éigse. See also §§ 8, 9.

Dr Fergus Kelly continued the preparatory work on The early Irish farm, which is to be published in the Early Irish Law Series. As general editor of the series he worked on Neil McLeod's edition of Early Irish contract law and Colin Ireland's Maxims of Flann Fína. An article entitled 'Old Irish círmaire' was accepted for publication in Celtica. See also §§ 7, 9.

Mr Rolf Baumgarten worked (with Siobhán Ní Laoire) on Bibliography of Irish Linguistics and Literature, 1972– which is now computerised for screen user and for providing printer's camera-ready copy. He also worked on an edition of In Lebor Gabála and edited Scéala Scoil an Léinn Cheiltigh/Newsletter of the School of Celtic Studies no. 3. Previously written and published (1968-) articles for Kindlers Neues Literature Lexikon (1988-) were revised. He supervised (with Siobhán Ní Laoire) FÁS personnel and completed (with Brendan Teeling) computerised indexes to Celtica vols 1-20. See also § 9.

Dr Malachy McKenna completed a draft edition of The Spiritual Rose which was submitted to the Director for comment and continued the computerisation of the typescript. Work on a register of School of Celtic Studies personnel progressed. A draft article on the conjugation of the verb in East Ulster Irish was completed. The following articles were accepted for publication: (i) 'A textual history of The Spiritual Rose' (Clogher Record); (ii) 'Historically-long stressed vowels in a south-east Ulster text' (Celtica). See also § 9.

Mrs Nessa Doran described NLI mss G 732 - G 773 and G 855 (which consists of 61 notebook mss). An article entitled 'Ceirdeanna na Scríobhaithe' was accepted for publication in Celtica 21.

Dr Colin Ireland's preparation of an edition of Bríathra Flainn Fína for the Early Irish Law Series reached the final stages; research on cultural contacts between Ireland and Anglo-Saxon Northumbria continued. He assisted with editing future issues of Celtica and in the preparation of the Catalogue and price list of Institute publications. An article entitled '"A coverchief or a calle": the ultimate end of the Wife of Bath's search for sovereignty' was accepted for publication in Neophilologus. See also § 7.

Mr Jürgen Uhlich continued work on his doctoral thesis on the morphology of Old Irish compound personal names. An article entitled 'DOV(A)- and lenited -B- in Ogam' was accepted for publication in Ériu 40. See also § 7.

Dr Aidan Breen continued work on an edition of Ailerán Interpretatio mystica ac moralis and commenced work on an edition of Synodus I Patricii from two new manuscripts and new fragments of Gildas Epistolae and other material. He began a new study of same for a projected monograph - the date, provenance and authorship of the Pseudo-Patrician canonical materials. The following articles were accepted for publication: (i) 'IDUMA (IΔOYMA)', Celtica 21; (ii) 'The text of the Constantinopolitan creed in the Stowe Missal', Proceedings of the Royal Irish Academy 1990. See also § 7.

Ms Kaarina Hollo continued work on an edition of Loinges Mac nDuil Dermait and prepared a short article on 'A aingil, beir' by Mael Ísu Ua Brolcháin for publication in Ériu 41. She co-edited Proceedings of the Harvard Celtic Colloquium 6 and 7. See also § 7.

Ms Ursula Marmé worked on 'Die Verbalcomposition im Altirischen' for a Ph.D. dissertation to be submitted to the University of Bonn. See also § 7.

Dr Pádraig Ó Macháin completed work on K. H. Jackson's edition of Aislinge Meic Con Glinne. See also § 7, 9.

Dr Seán Ua Súilleabháin's work on the Irish-Latin index to Richard Plunket's Vocabularium Latinum et Hibernicum progressed. An edition of the bardic poem 'Torchoir ceol Cloinne Cathail' with notes on musical references (jointly with Seán Donnelly) neared completion. See also § 9.

Dr Joseph F. Eska studied the evolution of Celtic word order and related matters for a forthcoming book. He worked on the so-called weak or dental preterite in continental Celtic, Watkin's Law and related matters with a view to publication as an article. The following articles were accepted for publication: (i) 'Syntactic remarks on the great inscription of Peñalba de Villastar' (Bulletin of the Board of Celtic Studies 37); (ii) 'Towards an integrated interpretation of the right panel of the Franks Casket', ANQ NS 3. See also § 7, 9.

Dr Karen L. Maund worked on the Irish Chronicles in (a) the British Library ms Cotton Titus A xxv and (b) the Bodleian ms Rawlinson B 488. Transcription of the former manuscript was completed. She read extensively on the historical background and context of the annals. An article entitled 'Fact and narrative fiction in the Llandaff Charters' was prepared for submission to the Journal of Mediaeval Studies.

3. STATUTORY PUBLIC LECTURE

A Statutory Lecture entitled 'The Irish Affiliations of the Catechesis Celtica' was delivered by Dr Máirtín Mac Conmara, MSC, at Trinity College, Dublin, on 8 September.

4. SEMINARS

Dr Colin Ireland's seminar on 'The Old Irish Bríathra: Wisdom ascribed to Fithal and Flann Fína' continued during the Hilary term.

A two day seminar on 'Phonology and History in Britain A.D. 400-600' was conducted by Dr Patrick Sims-Williams of Cambridge University on 26-27 October.

5. PUBLIC LECTURE

A Public Lecture entitled 'Linguistics in the USSR today' was delivered by Dr Vladimir E. Orel of the Academy of Sciences of the USSR, Moscow, on 22 September.

6. TIONÓL

The annual Tionól was held on Saturday 9 September for university and college staff and postgraduates. The following papers were read:

Damien Ó Muirí :	Aspects of gender in Irish
Séamas de Barra :	Pairlement Chloinne Tomáis
Art Hughes :	Old Irish ech: a geographico-linguistic approach
Patricia Kelly :	Lexical semantics and the analysis of Irish animal terms
Paul Russell :	Dúil Droma Cetta

7. EXTERNAL ACTIVITIES

Professor Brian Ó Cuív conducted post-graduate seminars on Irish dialects in St. Patrick's College, Maynooth, on 8, 15 and 22 February; he visited Biblioteca Apostolica Vaticana in Rome on 18 March and examined the Marianus Scottus manuscript, Codex Palatino-Vaticanus no. 830; he attended the symposium and meeting of the Council for Names Studies of Great Britain and Ireland in St Andrew's, Scotland, 31 March - 3 April; took part as Extern Examiner in the oral examination of Pádraig Ó Macháin for the Ph.D. degree in the University of Edinburgh on 3 April; lectured on 'Dinnshenchas - the literary exploitation of Irish place names' in the Queen's University of Belfast on 20 April; conducted a seminar on 'Filíocht na Gaeilge a chur in eagar - prionsabail oibre agus fadhbanna' in University College, Cork, on 10 May; attended the Second North American Congress of Celtic Studies in Halifax, Nova Scotia, 16-20 August, and read a paper on 'Celtic Studies - an Appraisal'; attended Ceiliúradh 150 bliain don Athair Peadar Ó Laoghaire in Baile Bhuirne, 17-19 November, and lectured on 'An tAthair Peadar agus an aithbheochan'.

Professor Máirtín Ó Murchú contributed to a colloquium held in Aberystwyth on 10 November for heads of Celtic Studies research centres.

Professor Proinsias Mac Cana lectured at Berkeley University and at the Eleventh Annual Celtic Studies Conference, University of California, Los Angeles on 'Tradition and innovation in early Irish poetics' (April); on 'Genre and topic in early Irish literature' at the University of Marburg (June); on 'Mythology and the Mabinogi' at the University College of Wales, Aberystwyth (July). He was elected a Foreign Honorary Member of the American Academy of Arts and Sciences and Member of Academia Europaea. As extern examiner he read the following doctoral dissertations: The Three Romances and the Four Branches - their narrative structure and relationsip with native Welsh lore, by Satoko Ito (University of Wales); Untersuchung zu Stellung und Funktion temporaler Adverbialausdrücke in mittelkymrischen und alt-/mittelirischen narrativen Prosatexten, by Erich Poppe (Philipps-University, Marburg); The Noun Clause in Early Irish: a historical and comparative study, by Ruairí Pádraig Ó hUiginn (Queen's University, Belfast).

Dr Fergus Kelly delivered the following lectures: (i) 'Early Irish Law and Society' at the History Department, University College Dublin, during January; (ii) 'Early Irish law' at the Law Department, University College Dublin, 23 February; (iii) 'Brehon Law' at Saorollscoil na hÉireann on 18 May and at Arbour Hill Detention Centre on 26 June; (iv) 'Life in ancient Ireland' at St Columba's College on 9 September; (v) 'War-cries and cries of grief in Irish and Welsh' at the Centre for Advanced Welsh and Celtic Studies, Aberystwyth, on 16 November; (vi) 'Court procedure and the rôle of the judge in early Irish law', Aberystwyth, 18 November. Dr Kelly attended the Irish Conference of Mediaevalists held at Maynooth, Co. Kildare, 13-15 July.

Dr Colin Ireland attended the Irish Conference of Mediaevalists held at Maynooth, Co. Kildare in July.

Dr Aidan Breen attended the Mediaeval History Conference at University College Cork in January.

Kaarina Hollo attended Léachtaí Cholm Chille XX at St. Patrick's College, Maynooth in February.

Ursula Marmé lectured on 'Semantics and functions of the Old Irish preverbs' at University College, Galway, on 5 December.

Dr Pádraig Ó Macháin conducted a postgraduate seminar on 'Ó Leitir go Labháin: saothar Fhearghail Óig Mheic an Bhaird' at University College, Cork, on 26 April.

Dr Joseph F. Eska attended the 64th Annual meeting of the Linguistics Society of America in Washington, 27-30 December.

8. CATALOGUING OF MANUSCRIPTS

Cataloguing of Irish manuscripts progressed under the general editorship of Pádraig de Brún:

Cornelius G. Buttimer, Catalogue of Irish manuscripts in the university of Madison - Wisconsin, was published during the year.

Work continued on other catalogues:
National Library of Ireland: Final revision effected of fasc. xii (Nessa Ní Shéaghdha), which is to appear early in 1990. Nessa Ní Shéaghdha also continued the preparation of fasc. xiii-xv.

Trinity College Dublin: Dr Aoibheann Nic Dhonnchadha continued work on the recataloguing of the medical manuscripts and Dr P. de Brún did some revision of his part of the new catalogue.

Other collections: First revision carried out of B. Ó Conchúir, Clár lámhscríbhinní Gaeilge Choláiste Ollscoile Chorcaí: cnuasach Uí Mhurchú; publication during 1990.

C. G. Buttimer, Catalogue of Irish manuscripts in Houghton Library, Harvard University, accepted for publication subject to revision.

Arrangements made for completion of R. Black's three-volume catalogue of the Gaelic manuscripts of Scotland; typescript received of vol. I (Classical Gaelic

manuscripts in the National Library of Scotland), and of part of vol. II (Vernacular [Scottish] Gaelic manuscripts in the National Library of Scotland), revised versions of both to be provided on computer disk; vol. III to deal with Scottish manuscripts held outside of NLS.

9. PUBLICATIONS

(a) Works in course of printing

Aislinge Meic Con Glinne edited by K. H. Jackson

(b) Books published by the Institute

Celtica 20
ed. Brian Ó Cuív. pp. 234. IR£12. ISBN 0 901282 96 0. ISSN 0669-1399

A guide to early Irish law (Early Irish Law Series Vol. III)
Fergus Kelly. pp. xxiv + 358. IR£16. ISBN 0 901282 95 2. ISSN 0790-4657

East Perthshire Gaelic
Máirtín Ó Murchú. pp. xi + 432. IR£24. ISBN 0 901282 93 6

Catalogue of Irish MSS in the University of Wisconsin-Madison
Cornelius Buttimer. pp. viii + 52. IR£5. ISBN 1 85500 00 6. ISSN 791-1890

(c) Books published outside the Institute

Proinsias Mac Cana (co-editor)

Ériu xl. pp. 194
Royal Irish Academy

Rolf Baumgarten (co-editor)
Ériu xl. pp. 194
Royal Irish Academy

Joseph F. Eska
Towards an interpretation of the Hispano-Celtic inscription of Botorrita.
Innsbruck: Institut für Sprachwissenschaft der Universität Innsbruck 1989
pp. xi + 213.
(Innsbrucker Beiträge zur Sprachwissenschaft 59).

(d) Reprints

Irish Dialects Past and Present by T. F. O'Rahilly

The Annals of Inisfallen ed. Seán Mac Airt

A grammar of Middle Welsh by D. Simon Evans

(e) Contributions to periodicals and other publications

Brian Ó Cuív

Bróga ar nós Polónia
Celtica 20 (1989) 28

Two religious poems in Irish
ibid. 73-84

Reviews: Allen James, John Morris-Jones; Tomás de Bhaldraithe, Foirisiún Focal as Gaillimh; Caoilfhionn Nic Pháidín, Cnuasach Focal ó Uíbh Ráthach; A. O'Sullivan, P. Ó Riain (ed.), Poems on Marcher Lords; D. P. Ó Baoill, Lárchanúint don Ghaeilge; D. P. Ó Baoill, Foclóir Póca; Katharine Simms, From Kings to Warlords; Colin B. D. Mark, Gaelic Verbs; Cyril Ó Céirín, (trans.) My story (by Peter O'Leary); Gordon W. MacLennan (ed.), Proceedings of the First North American Congress of Celtic Studies; Studia Celtica xx/xxi; Zeitschrift für Celtische Philologie Band 42.
ibid.
Obituary: Heinrich Wagner (1923-1988)
ibid. 233-4.

Máirtín Ó Murchú

The phonology of a Perthshire Idiolect
Scottish Gaelic Studies 15 (1988) 20-73.

Diglossia and Interlanguage Contact in Ireland
Language, Culture and Curriculum 1.3 (1989), 243-49.

Comhthèacs don Ghaeilge ar scoil
Comharscéala 1989, 11-12.

Proinsias Mac Cana

La traduction des épopées etrangeres en irlandais
Traduction et traducteurs au Moyen Age, Colloque Internationale du CNRS, 26-28 mai 1986 (Paris 1989) 77-84.

Notes on the combination of prose and verse in early Irish narrative
Early Irish literature: media and communications / Mündlichkeit und Schriftlichkeit in der frühen irischen Literatur ed. Stephen N. Tranter and Hildegard L. C. Tristram (Tübingen 1989) 125-47.

The Voyage of St Brendan: literary and historical origins
Atlantic Visions, ed. John de Courcy Ireland and David C. Sheehy (Dún Laoghaire 1989) 3-16.

Pádraig de Brún
Lament for Garret Pierse of Aghamore, slain at Liscarroll, 1642
Kerry Archaeological & Historical Society Journal 20 (1987 [1989]) 5-27 [with John H. Pierse].

Fergus Kelly
Review of Charles-Edwards, Owen and Walters (eds.), Lawyers and laymen
Celtica 20 (1989) 227-9.

Rolf Baumgarten

James Carney: a bibliography
Sages, saints, and storytellers: Celtic Studies in honour of Professor James Carney, ed. D. Ó Corráin et al. (Maynooth 1989) 463-72.

The syntax of Irish ar marb, ar mbeo : ar mairb, ar mbí,
Ériu 40 (1989) 99-112.
The School of Irish Learning, Newsletter 3 (1989) 30-6.
Irish Studies Theses 1988/89, Newsletter 3 (1989) 24-9.

Seán Ua Súilleabháin
Deilbhíocht Bhriathra an Tarna Réimniú i nGaeilge Iarthar Mhúscraí
Celtica xx 145-166

Pádraig Ó Macháin
An Irish manuscript in Edinburgh University Library
Scottish Gaelic Studies 15 (1989) 98-102

Joseph F. Eska
A Gallo-Italic dialectal formation
Die Sprache 33 (1987 [1989]) 108-111

The verbal desinence - Tus in the Hispano-Celtic inscription of Botorrita
Zeitschrift für celtische Philologie 42 (1989) 214-222

III - Annual Report of the Governing Board of the School of Theoretical Physics for the year ended 31 December 1989, adopted at its meeting of 24 September 1990.

1 STAFF, EMERITI PROFESSORS, SCHOLARS, RESEARCH ASSOCIATES, VISITING SCIENTISTS

Staff:

Senior Professors:

John T. Lewis, Director from 1 January 1975; Lochlainn S. O'Raifeartaigh.

Librarian-Executive:

E.R. Wills.

Secretary:

M. Matthews; on career break from 6 August 1988.

Emeriti Professors:

John L. Synge; James R. McConnell.

Scholars:

W.Cegla (Poland) left 30 September; N. Gorman (Ireland); T. C. Dorlas (Netherlands) left 30 September; J. Balog (Hungary); M.P. Tuite (Ireland) returned from leave of absence on 1 July; L.G. Fehér (Hungary); R. Werner (Fed. Rep. Germany); D. J. O'Connor (Ireland) from 1 October; N.G. Duffield (UK) from 1 October; L. Dabrowski (Poland) from 1 November.

Research Associates:

Re-appointed to 31 December 1990:

TCD: D.J. Bradley, R.K. Dodd, P.S. Florides, B.K.P. Scaife, D. Weaire

UCD: P.A. Hogan, D.J. Judge, J.D. McCrea, J.V. Pulé, W. Sullivan

St. Patrick's College Maynooth: B. Dolan, C. Nash, A. O'Farrell J.A. Slevin, J. Spelman, D.H. Tchrakian

UCG: M.J. Conneely, T.N. Sherry

DIT Kevin St: J. Burns, T. Garavaglia, B. Goldsmith, M.J. Tuite

DIT Bolton St: P. Houston

DCU: M. Barman, E. Buffet, J. Burzlaff, D. Heffernan

Limerick Univ.: R.H. Critchley, J. Kinsella, B. Lenoach

Carlow RTC: D. O Sé

Cork RTC: M. Vandyck

An Foras Forbartha: J.M. Golden

Open University: A.I. Solomon

Oxford University: R.C. Flood

U.C. Irvine: P. McGill

New appointments, to 31 December 1990:

Meteorological Service: P. Lynch

Dept. of Finance: A.J. Curran

Visiting Scientists:

J. Bell (Geneva) 4-8 Dec., M. van den Berg (Heriot-Watt) 8-14 Aug., P. Boulanger (Brussels) 19-22 Dec., D. Buchholz (Hamburg) 30 June - 14 Aug., A. Chakrabarti (Paris) 9-13 Oct., Th. Dorfmuller (Bielefeld) 15-22 Apr., T.C. Dorlas (Swansea) 10-14 Nov., N. Duffield (Heidelberg) 12-23 June, M. Fannes (Leuven) 21 Apr. - 23 May, G.W. Ford (Ann Arbor) 5 June - 27 July, J.-L. Gervais (Paris), 24-25 May, G.A.C. Graham (Simon Fraser) 13 Nov. - 21 Dec., T. Kephart (Nashville) 12-27 Aug., M. Koca (Turkey) 15-25 Sept., Y.A. Kubyshin (Moscow) 20-26 Nov., Z-Q. Ma (Beijing) 20 Apr. - 26 May, W. McGlinn (Notre-Dame) 2-9 June, R. Musto (Naples) 29 Apr- 3 June, R.F. O'Connell (Baton Rouge) 6-30 June, S. Odinstov (Tomsk) Nov.20 - 1 Dec., D.Y. Petrina (Kiev) 19 Nov. - 3 Dec., D. Petz (Budapest) 25 Feb. - 3 Mar., C. Pfister(Lausanne) 1 - 31 Mar., H. Roos (Göttingen) 9 Oct. - 2 Dec., G. Sabbin (Newfoundland) 21 Sept. - 12 Oct., G. Savvidy (Yerevan) 23 May - 9 June, L. Schmitt (Osnabrück) 6 - 10 Nov., A. Sedrakyan (Yerevan) 23 May - 9 June, N. Sil (Calcutta) 11-13 Sept., W.I. Skrypnik (Kiev) 19 Nov. - 3 Dec., C. Stephens (Imperial College) 4-8 Dec., Y. Suhov

(Moscow) 10 - 25 Aug., 4 - 15 Sept., H. de Vega (Paris) 18-29 May, A. Verbeure (Leuven) 16-21 Mar., M. Winnink (Groningen) 28 Nov. - 15 Dec., A. Wipf (Munich) 2-9 June, V.A. Zagrebnov (Dubna) 30 Oct. - 30 Nov.

2 GENERAL

International cooperation was again a prominent feature of the activities of the school:

A workshop on 'Trends in Theories of Fundamental Interactions', involving sixty-six participants from overseas and from colleges in Ireland, was held in May.

Draft protocols on scientific cooperation with the Laboratories of Theoretical Physics in two major research institutes in the Soviet Union (the Joint Institute for Nuclear Research in Dubna and the Institute of Physics in Yerevan).

Two three-year contracts for research proposals involving cooperation with the School were awarded by the US National Science Foundation (to the University of Syracuse and the University of Notre Dame in theoretical particle physics and to Louisiana State University, Baton Rouge, and the University of Michigan, Ann Arbor, in statistical mechanics).

3 RESEARCH AND STUDY

Primary areas -:

3.1 Theoretical Particle Physics

Prof. L. O'Raifeartaigh's main thrust of research during the year was on the reduction of the standard two dimensional conformally invariant Wess-Zumino-Witten theory to other conformal field theories, in particular to Toda field theories. The reduction yield a particularly simple derivation of the general solution to the Toda field equations and a simple intuitive insight into the nature of the so-called W-algebras proposed by Zamalochikov and realized in the context of Toda theory by Gervais. This work was done in collaboration with Drs. Balog, Fehér, Forgacs and Wipf. Earlier research on the centre of Virasoro algebras with Drs. Gorman and McGlinn, and on the supersymmetry of the Dirac operator for self-dual gauge fields with Drs. Fehér and Horvathy, was completed.

Dr. M.P. Tuite continued his work on conformal field theory. He investigated the Monster Module described by Frenkel, Lepowsky and Meurman and its Moonshine properties conjectured by Conway and Norton. He made considerable progress by showing how these properties can be understood in terms of orbifolds.

In addition to his work on Kac-Moody and Virasoro algebras, Dr. Gorman collaborated with Profs. Spearman and Ciulli on a maximum entropy method for image reconstructions.

Dr. Dabrowski investigated quantum groups, exactly solvable models and the Wess-Zumino-Witten model.

Dr. Tchrakian continued his work on the construction of localized instantons (with Dr. O'Brien) and their applications (with Dr. Savvidy). He completed his work with Prof. Ma on generalized self-duality and on classical solitons. He began work on generalized Skyrme models in arbitary dimensions with Drs. Kerner and Manton and on the quantization of localized solitons with Prof. Muller-Kirsten.

In addition to his work on the reduction of Wess-Zumino-Witten theory, Dr. Fehér worked on supersymmetric quantum mechanics.

Dr. M.J. Tuite continued his study of thermal field theories, in particular applications of the field-theoretic functional Schrödinger picture. He also began a study of the Vilkovisky-DeWitt effective action and its use in quantum field theories.

Dr. O'Connor continued his study of finite-size effects. Recent results concern the crossover from $4 - \epsilon$-dimensions to $3 - \epsilon$-dimensions when S^1 is contracted to a point. He also investigated higher dimensional knots via path-integrals, q-deformations of groups and the implications of his work for statistical mechanics.

3.2 Classical Statistical Mechanics

Prof. McConnell continued his studies of nuclear magnetic relaxation and of Poley absorption in liquids. He investigated, with Prof. Burshtein, the consequences of non-instantaneous molecular collisions.

Drs. Buffet and Pulé continued their investigation of the dynamics of polymers.

Prof. Scaife worked on problems concerned with dielectrics and ferrofluids. He was also involved in editing Vol IV of Hamilton's collected works.

3.3 Quantum Statistical Mechanics

Prof. Lewis continued his investigations of models of an interacting boson gas using the Large Deviation Principle. The work was done in collaboration with Drs. van den Berg, Pulè and Dorlas. The main achievements were the proof that the free boson occupation measure satisfies a Large Deviation Principle and the construction of a functional which discriminates between atomic and continuous measures. Using these results, the work on the Huang - Yang- Luttinger model was completed. New results were obtained on some perturbed mean-field models. Together with Prof. Suhov, the group studied Gaussian domination and reflection positivity in lattice models of a boson gas. Prof. Lewis, Drs. Dorlas and Pulé began work with Dr. Zagrebnov on a BCS-type model of an interacting boson gas.

In addition to his work on models of an interacting boson gas, Dr. Dorlas continued his work on soluble models and on renormalization-group theory.

Dr. Werner pursued two main lines of research: he continued his work with Dr. Raggio on equilibrium properties of mean-field systems and extended it to the study of the dynamics of such systems with Dr. Duffield and Prof. Roos; he began the study of finitely correlated states on quantum spin chains with Drs. Nachtergaele and Fannes.

Profs. Ford and O'Connell continued their collaboration with Prof. Lewis under the NSF International Programme on applications of the quantum Langevin equation. Prof. Ford and Dr. Raggio investigated tunneling in a spin-boson model.

Dr. Duffield's research was in quantum statistical mechanics and mean-field dynamical semigroups.

Dr. Buffet worked on the dynamics of polymers.

3.4 Quantum Theory and Quantum Electronics

Dr. Conneely's main field of research was in atomic physics.

Dr. Garavaglia worked on chaotic beam dynamics and quantum limits. He also investigated photon and gluon radiation from interacting beams, and squeezed chaotic quantum states.

Dr. Heffernan's main field of research was nonlinear physics. In particular, he investigated problems concerning lasers, nonlinear optics and quantum electronics

Dr. Houston worked on the operator ordering problem for gauge invariant quantum models.

Dr. Solomon's main areas of research were quantum optics, Lie algebras in condensed matter physics and superalgebras in condensed matter physics.

3.5 General Relativity and Gravitation

Dr. Dolan continued his research on general relativity and in quantum field theory.

Dr. McCrea, in collaboration with Profs. Kopczyński and Hehl, derived the relation between the Hilbert and Noether energy-momentum currents in a natural way in the context of the variational formalism of the Poincaré gauge theory. In work with Profs. Hehl, Mielke and Ne'eman, a GL(4,R) gauge approach to gravitational theory was developed in which the metric and the affine connection acquire the status of independent fields.

Dr. Vandyck's research was in two distinct areas: supergravity and general relativity. In supergravity, the study of space-time symmetries was continued. The relationship with superspace was clarified, in relation with spinorial Lie derivatives. In relativity, working with Prof. O'Raifeartaigh, the physical degrees of freedom of the gravitational field were obtained via the new Ashtekar variables.

3.6 Applied Mathematics

Dr. Barman worked on a compiler for the programming language 'LASS'.

Dr. Lynch worked on the development of time integration techniques for numerical weather prediction.

Dr. Burzlaff's main work was on radiation from bent optical fibres, formulated as an eigenvalue problem,in collaboration with Prof. A. Wood. The solution of the problem requires improved asymptotic expansions. Dr. Burzlaff worked also on vortex scattering in superconductors with Mr. MacCarthy.

3.7 Pure Mathematics

Dr. Burns worked on differential geometry, especially the study of symmetric spaces and manifolds without conjugate points.

Dr. Goldsmith's main areas of research were applications of set and model theory to abelian group theory and he also worked on transitive and fully transitive abelian groups.

Research Reports

Research work during the year was written up in the first instance in research reports. Two lists of titles of these reports (preprints) were prepared and circulated to a mailing list of approximately 300 research institutes and university departments throughout the world. As far as possible, copies of the preprints were sent out in response to requests. Many of the reports appeared later as publications, or were in press at the end of the year (See section 11).

DIAS-STP-89-

-01: M. VAN DEN BERG, T.C. DORLAS, J.T. LEWIS, & J.V. PULÉ: A perturbed mean field model of an interacting boson gas and the large deviation principle.

-02: N. GORMAN, L. O'RAIFEARTAIGH, & W. McGLINN: Cartan-preserving automorphisms of twisted and untwisted Kac-Moody algebras.

-03: D.M. HEFFERNAN, J. O'GORMAN, B.J. HAWDON, & J. HEGARTY: Feedback induced instabilities in external cavity injection lasers.

-04: D. M. HEFFERNAN, J. O'GORMAN, B.J. HAWDON, & J. HEGARTY: Frequency locking and quasiperiodicity in a modulated external cavity injection laser.

-05: J.R. McCONNELL: The Poley absorption problem.

-06: J.T. LEWIS: Mark Kac Seminar on probability and physics syllabus.

-07: M. VAN DEN BERG, T.C. DORLAS, J.T. LEWIS, & J.V. PULÉ: The pressure in the Huang-Yang-Luttinger model of an interacting boson gas.

-08: B.P. DOLAN: Explicit evaluation of the BRST operator for Ashtekar's chiral gravity.

-09: G.A. RAGGIO, & R.F. WERNER: Minimizing the relative entropy in a face.

-10: G.A. RAGGIO, & R.F. WERNER: The Gibbs variational principle for general BCS-type models.

-11: R.F. WERNER: Quantum states with Einstein-Rosen-Podolsky correlations admitting a hidden-variable model.

-12: R.F. WERNER: Dilations of symmetric operators shifted by a unitary group.

-13: N. GORMAN, L. O'RAIFEARTAIGH, & W. McGLINN: A streamlined highest weight derivation of the bilinear Virasoro centre.

-14: L.G. FEHÉR, P.A. HORVÁTHY, & L. O'RAIFEARTAIGH: Applications of chiral supersymmetry for spin fields in self-dual backgrounds.

-15: E. BUFFET, & J.V. PULÉ: On Lushnikov's model of gelation.

-16: B.P. DOLAN: The generating function for Ashtekar's canonical transformation in the presence of torsion.

-17: P. FORGÀCS, A. WIPF, J. BALOG, L. FEHÉR, & L. O' RAIFEARTAIGH: Liouville and Toda theories as conformally reduced WZNW theories.

-18: A.A. TSEYTLIN: On the renormalization group approach to string equations of motion.

-19: R.F. WERNER: Remarks on a quantum state extension problem.

-20: L.G. FEHÉR, P.A. HORVÁTHY, & L. O'RAIFEARTAIGH: Separating the dyon system.

-21: B.P. DOLAN: The extension of chiral gravity to SL(2.C).

-22: M. FANNES, B. NACHTERGAELE, & R. F. WERNER: Exact antiferromagnetic ground states of quantum spin chains.

-23: G.A. RAGGIO, & R.F. WERNER: The Gibbs variational principle for inhomogeneous mean-field systems.

-24: J.R. McCONNELL: Inertial theories of dielectric relaxation in liquids.

-25: T. GARAVAGLIA: The characteristic functions for the squeezed coherent chaotic photon state with applications to the Jaynes-Cummings model.

-26: Z.-Q. MA, & D.H. TCHRAKIAN: On the stability of gauge fields in higher dimensions.

-27: J.L. SYNGE: In honor of Nathan Rosen: Concepts.

-28: Yu. SUHOV: Towards time-dynamics for bosonic systems in quantum statistical mechanics.

-29: D.H. TCHRAKIAN, H.J.W. MUELLER-KIRSTEN, & J.-Z. ZHANG: Stability of metastability and eigenvalues of the equation of small oscillations.

-30: J. BALOG, L. FEHÉR, L. O'RAIFEARTAIGH, P. FORGÁCS, & A. WIPF: Toda theory and W-algebra from a gauged WZNW point of view.

-31: VI. V. PAPOYAN, & V. A. ZAGREBNOV: On general Bose-Einstein condensation in the almost ideal boson.

-32: W.I. SKRYPNIK: On the function integrals associated to a special Gibbs system with 3 body potentials.

4 SEMINARS, REVIEW LECTURES, SERIES, COURSES

Seminar and review lectures, series, and courses, in specialised areas of physics and mathematics were given at DIAS-STP throughout the year, by members or visitors; as in previous years these were attended by members of staff and students from the universities and other third level and research institutes in the Dublin Area, and by members of the scientific schools of DIAS.

Seminars and lectures were given also at the Journal's Club and other Irish venues, by the School's members and visitors.

4.1 Seminar and review lectures given at DIAS-STP:

Dr. J.S. Bell (CERN): Quantum jumps.

Dr. M. van den Berg (Heriot-Watt): Asymptotics of the eigenvalue counting functions.

Dr. J. Balog: Classical Toda and Liouville theory.

Dr. W. Cegla: The anisotropic Curie-Weiss model.

Dr. B. Dolan: Ashtekar's variables for canonical gravity.

Dr. N.G. Duffield (Heidelberg): Phase transitions in random quantum spin systems and their classical analogues.

Dr. N.G. Duffield: Introduction to neural networks I.

Dr. N.G. Duffield: Introduction to neural networks II.

Prof. M. Fannes (Leuven): A class of states for one-dimensional lattice systems.

Dr. L. Fehér: Classical W-algebras.

Dr. T.W. Kephert (Nashville): Discrete systems with topological charge.

Prof. C. King (Cornell): An equation for Knot-invariants from the Chern-Simons theory.

Prof. M. Koca (Adana Univ. and CERN): Octonionic symmetries of the root diagram of E_8.

Dr. Y. Kubyshin (Moscow): Dimensional reduction.

Prof. Z-Q. Ma (Beijing): Knots.

Prof. V. Moncrief (Yale Univ.): How soluble is Witten's 2+1 dimensional topological gravity.

Dr. S. Odinstov (Tomsk, USSR): Asymptotic freedom and asymptotic finiteness in grand unified theories in flat and curved space.

Dr. D. Petz (Leuven and Budapest): From conditional expectation to extension of states of von Neumann algebras.

Prof. C. Pfister (Lausanne): On the Wetting transition in the Ising model.

Dr. J.V. Pulé: Functional integration and diamagnetism.

Prof. G.K. Savvidy (Yerevan): SU(∞) gauge theories and relativistic membranes.

Dr. L. Schmidt (Osnabruck): Non-commutative differential geometry and its application to the quantum Hall effect.

Prof. Yu. Suhov (Moscow): Dynamics of a quantum particle system.

Dr. M.P. Tuite: The monster group in string theory.

Prof. H. de Vega (Univ. Pierre and Marie Curie, Paris):
Yang-Baxter algebras and quantum groups.

Prof. A. Verbeure (Leuven): Correlation algebras.

Prof. M. Winnick (Groningen): The Gibbs phase rule.

4.2 Series and courses given at DIAS-STP:

A series of informal working seminars on Quantum Groups was held by Dr. Dabrowski.

A series of informal seminars on Conformal Field Theory, Jan. - April was held by Dr. Gorman.

4.3 Contributions to the Journal's Club (Joint TCD-UCD-Maynooth-DIAS Meeting):

N. Gorman : Introduction to BRST Quantization

4.4 Other lectures or seminars given in Ireland by members of the DIAS-STP:

Prof. Lewis:

Laws of large numbers in analysis, Conf. of Irish Mathematical Society, St. Patrick's College, Maynooth, September.

Dr. Hefferman:

Frequency locking and chaos in modulated external cavity injection lasers, paper read at Nat. Conf. of the Optoelectronics Group, U.C.G. in June.

Stability characteristics on nonlinear delay systems, paper read at the Sixth Inter. Conf. on the Numerical Analysis of Semiconductor Devices and Integrated Circuits, T.C.D. 11-14 July.

Dr. Fehér:

Applications of chiral supersymmetry for spin-fields, T.C.D. in March.

Dr. Chakrabarti:

Periodic and Quasi-periodic instantors, T.C.D. in October.

5 ACTIVITITES OUTSIDE IRELAND

Prof. Lewis attended a conference on Probability Theory and its Applications, University of Edinburgh, 9-14 April. He attended a symposium on Mathematical Physics in the University of Groningen, 2-4 October. He participated in a Conference on Diffusion Processes and Related Problems in Analysis at North Western Univ., Evanston, 21-28 October and visited the Univ. of Michigan, Ann Arbor, 29-31 October, for discussions with Profs. Ford and Conlon. He visited the Free University of Berlin for five days in December. Prof. Lewis, Drs. Dorlas and Pulé visited the Joint Institute for Nuclear Research, Dubna, USSR, 22 May- 8 June, under the exchange agreement and collaborated there with Drs. Zagrebnov and Priezzev. They participated in a Conference on Quantum Models of Statistical Mechanics: Rigorous Results. Details of lectures given are set out in Section 5.1.

Prof. O'Raifeartaigh attended the 3rd. Regional Conference on Mathematical Physics, Islamabad, Pakistan, 13-20 February, the 3rd. Adriatic Conference on Particle Physics, Dubrovnic, Yugoslavia, 11-17 June, and the Conference on Geom. and Topological Methods in Mechanics, Calgary, Canada, 21-23 June.
He also attended the Summer School for Science Graduates, European, at the University of Ghent, Belgium, 20-25 August. He visited the University of Calgary from 26-30 June and held a visiting professorship at the University of Zurich during November and December. Details of lectures given are set out in Section 5.1.

Prof. McConnell attended the Third Chianti Workshop on Magnetic Resonance entitled 'Nuclear and Electron Relaxation' at San Miniato, Italy, 28 May -2 June. Here he had discussions, with Prof. L. Banci (Florence) and Prof. C. Luchinat (Bologna), on nuclear and electronic relaxation and with Prof.L. Salikhov (Kazan, USSR) on the treatment of nonadiabatic terms in the formalism of quantum electrodynamics and nuclear magnetic resonance.He visited the departments of physics and of electrical engineering of the University of Pavia. He also attended the VII Annual Conf. of the European Molecular Liquids Group on 'Statistical Mechanics of Chernically Reacting Liquids', 11-15 September at Novosibirsk. He visited the Organic Chemistry Institute at Irkutsk. He had discussions with Prof. V.I.Gaiduk (Moscow) on the physical significance of finite molecular collision times and with Prof. V.A. Zamkov (Leningrad) on dielectric theory.

Dr. Dolan attended the Conference of the U.K. High Energy Physics Institute, University of Durham, 21 August - 1 September.

Drs. Gorman, Fehér and Balog attended the conference of the U.K. Institute for High Energy Physics, Durham, 26 August - 2 September. Dr. Gorman visited Montpellier, France under EOLAS/CNRS exchange agreement, 20 April - 21 May, which included a brief visit to University of Mainz, West Germany. He also visited Notre Dame, Indiana for discussions with Prof. W. McGlinn in December. Dr. Balog participated in the Karpacz Winter School, Karpacz, Poland, 20 February - 5 March and also attended the Rutherford Lab. Annual Conf., Oxford, 17-20 December. He also attended the 3rd. Hellenic School on Particle Physics, Corfu as an invited speaker.

Dr. Burzlaff attended the Differential Equations Meeting in Dublin, 22-25 May and the 4th. ECMI Meeting on Industrial Mathematics, St. Wolfgang, 29 May - 2 June.

Dr. Fehér attended a Conference on Symplectic methods in physics, CIRM, Marseille, France, 15-19 May, and the 10th. UK Institute for Theoretical Physics, Durham, England, 26 August - 2 September. He also attended, with Dr. M.P. Tuite, the Cosener's House weekend workshop of conformal field theory, Abingdon, Oxford, 25-26 November. Drs. Fehér and O'Connor attended the Annual Rutherford meeting on particle theory, Abingdon, Oxford,18-20 December. Dr. Fehér was invited for discussions to DAMTP, Cambridge, 4-8 December.

Dr. Garavaglia attended a conference at UT Austin in December. He also attended the International symposium on the SSC, Miami, 13-20 March and The American Physics Society Meeting, Washington,DC, 15-20 April.

Dr. Lynch attended the European Geophysical Society, General Assembly, Barcelona, Spain, 13-17 March, the Inter. Assoc. of Meteorology and Atmospheric Physics, Scientific Assembly, Reading, England, 31 July - 10 August, and the Conference on Numerical Weather Prediction, Oslo, Norway, 28-31 August.

Dr. Solomon visited Technion, Hafa, Israel, 11-26 March, and the University of Oxford 10-14 July.

Dr. Goldsmith visited the Universität Essen GHS for three weeks in February. He was co-director of an EC sponsored workshop at Yarmouk Univ., Irbid, Jordan from 15 March -1 April on Algebra and Applied Mathematics. He attended the Conference on Abelian Groups, Math. Forschinginstitut, Oberwolfach in June.

Dr. McCrea was an invited lecturer at the First Brazilian School of Computer Algebra, Rio de Janeiro, 5-11 August.

Dr. Conneely attended the 16th. Inter. Conference on the Physics of Electronic and Atomic Collisions, New York, 26 July - 1 August.

5.1 Seminars, Lectures and Courses given abroad:

Prof. Lewis:

Lectures: The large deviation principle and some models of an interacting boson gas (Edinburgh Conf.)

Rigorous results on boson condensation: a review (Dubna Conf.)

Asymptotics of operator traces and the large deviation principle (Evanston Conf.)

Seminar: The large deviation principle in statistical mechanics (Dept. of Mathematics, Univ. Michigan,Ann Arbor)

Prof. O'Raifeartaigh

Lectures: Covariant formulation of bosonic string theory in the light-cone gauge (Islamabad Conf.)

Toda field theory as constrained Wess-Zumino-Witten theory (Adriatic Conf).

Reduction of Wess-Zumino-Witten theories to Integrable Toda theories.(Calgary Conf.)

Spontaneously broken symmetry (Ghent Conf.)

Two-dimensional conformal field theory (Univ. of Calgary)

String theory and Kac-Moody algebras (Univ. of Calgary)

Series of Lectures:
Gauge theory of the fundamental interactions (Zurich Univ.)

Prof. McConnell

Seminars: E. Schrödinger filosofo della scienza (Pavia)

Nuclear magnetic spectral densities (Irkutsk)

Lectures: The Poley absorption problem (Novosibirsk)

Schrödinger (English Club Novosibirsk)

Dr. Pulé

Lectures: The perturbed mean-field model of an interacting boson gas (Dubna Conf.)

The Yang-Yang trace formula and the large deviation principle (Evanston Conf.)

Dr. Dorlas

Lecture: An exactly soluble Bose-gas model (Dubna)

Dr. O'Connor

Lecture: A unitary bound on cold fusion (U.C.C.)

Dr. Solomon

Lecture: Superalgebraic approach to superconductivity (RSRE Malvern)

Dr. Goldsmith

Seminars: Endomorphism rings of abelian groups (Univ. of Jordan, Amman)

Transitive and fully transitive groups (Univ. of Exeter)

Endomorphism algebras of modules over complete discrete valuation rings (Oberwolfach)

Dr. McCrea

Series of Lectures:

REDUCE in general relativity and Poincaré gauge theory. (Rio de Janeiro)

The application of EXCALC in gauge theories of gravitation. (University of Brasilia)

D. Heffernan

Lecture: Frequency locking, quasiperiodicity and chaos in modulated external cavity injection lasers, paper read at the Inter. Conf. on Coherence and Quantum Optics, Univ. of Rochester, New York, 26-28 June.

6 STATUTORY PUBLIC LECTURE

A Statutory Public Lecture under the auspices of the School was delivered by Dr. J.S. Bell, FRS, on 5 December in University College Dublin. The title was '..... but not malicious ? (Einstein said: Subtle is the Lord, but malicious he is not)'. The subject of the lecture was the continuation of Einstein's argument with Bohr about apparent action at a distance in quantum mechanics.

7 SYMPOSIA

Two Mathematical Symposia were held during the year, 21-22 March and 21-22 December. The attendance (45 in March, 56 in December) included professors, lecturers, and graduate students from the Irish universities and other third-level and research institutes, and from institutes abroad, and members of the scientific schools of DIAS.

Lectures were given as follows:

March

Review Lectures:

Prof. A. Verbeure (Leuven): Equilibrium Measures.

Prof. R. Nagel (Tubingen): Positivity in Pure and Applied Functional Analysis.

Lectures:

Prof. A. O'Farrell (Maynooth): Boundary Smoothness Properties.

Prof. F. Hodnett & Mr. T. Moloney (Limerick):
Reformulation of the N-Soliton Solution of the Kdv Equation.

Prof. J. Flavin (UCG): The method of cross-section for partial differential equations.

Dr. C. Nash (Maynooth): Topological Quantum Field Theory.

Short Talks:

Dr. M. Stynes (UCC): Numerical analysis of problems with boundary and/or interior layers.

Prof. A. Wood (DCU): Exponentially small eigenvalues of differential operators.

Dr. M. Newell (UCG): The N-centre of a group.

Dr. R. Hart (Belfast): The ghost of an index-theorem.

Prof. N. O'Murchadha (UCC): A Poincaré inequality for compact manifolds.

Dr. T. Murphy (TCD): Cubic splines.

December

Review Lectures:

Prof. L.O'Raifeartaigh (DIAS): Kac-Moody algebras.

Prof. P. Boulanger (Brussels): Linear and non-linear waves in magneto-elasticity.

Lectures:

Prof. M. Newell (UCG): The n-centre of a group.

Prof. A. Wood (DCU): Exponentially small eigenvalues and Stoke's lines.

Prof. J.T. Lewis (DIAS): Large deviations and the asymptotics of operator traces.

Dr. N. Devaney (Dunsink): Wiener's filter and image sharpening in astronomy.

Short Talks:

Prof. N.O Murchadha (UCC): Magnetic monopoles and superconducting cosmic strings.

Dr. G. Ellis (UCG): Five important commutator relations.

Dr. T. Murphy (TCD): Primes in C.

Dr. M. Vandyck (RTC) and Prof. N.O Murchadha (UCC):
Ashtekar's variables in general relativity: simple application.

Dr. J. Sexton (IBM - Yorktown Heights): Super computers for lattice gauge theory.

Dr. P. Lynch (Met. Service): Filtering integration schemes based on the Laplace and Z transforms.

8 IRISH MECHANICS SOCIETY MEETING

A two day conference, in association with University College Dublin, was held on 20th. and 21st. December. Lectures were held in University College Dublin on 20th. Dec. and in the Institute on 21st. Dec. Lectures given at DIAS were as follows:

Prof. K.R. Rajagopal (U. Pittsburgh):
Diffusion of liquids through anisotropic solids.

Prof. C.V. Massalas (U. Ioannina, Greece, and TCD):
Generalized thermoelasticity of magnetizable elastic solids.

Dr. J.M. Golden (ERU), Prof. G.A.C. Graham (Simon Frazer and DIAS):
A proposed method for measuring the complex modulus of a thick viscoelastic layer.

Dr. D.W. Reynolds (DCU): The asymptotic behaviour of creeping columns.

9 WORKSHOP

A working seminar entitled 'Trends in Theories of Fundamental Interactions', in association with St. Patrick's College, Maynooth, Trinity College, and University College Dublin was held in The Dublin Institute for Advanced Studies from Monday 22nd. May until Friday 26th. May inclusive. There was a large attendance (66 in all) comprising overseas participants and participants from third level institutes and colleges in Ireland.

Lectures were given as follows:

Dr. L. Alvarez-Gaume: Quantum groups and conformal field theory.

Dr. A.P. Balachandran: Statistics, strings and gravity.

Dr. D. Birmingham: BRST quantization and renormalization of topological field theory.

Dr. C. Callan: Open string theory and dissipative quantum mechanics.

Dr. P. Forgács: Liouville and toda theories from WZNW theories.

Dr.J-L. Gervais: Liouville and toda theory and extended virasoro algebras.

Dr. M. Green: Some recent developments in string theory.

Dr. B. Grossman: Topological quantum theory of vortices and knots.

Dr. R. Jackiw-1: Chern-Simons field theory.

Dr. R. Jackiw-2: Quantum gravity in flatland.

Dr. C. Klimcik: 'In and out' Vertex operators in a class of UV-finite sigma models.

Dr. Z-Q. Ma: Yang-Baxter equation and quantum s1(2) enveloping algebra.

Dr. W. McGlinn: Virasoro centres.

Dr. G. McKeon: Quantum corrections to sigma-models.

Dr. A. Niemi: Topological YM theory is abelian chiral anomaly in a superspace.

Dr. S-Y. Pi: Early universe physics.

Dr. N. Sanchez: Strings and quantum gravity.

Dr. C. Schmid: Normal ordering and the fermionic energy-momentum produced by an external gravitational field.

Dr. A. Semikhatov: Conformal theories on Riemann surfaces.

Dr. R. Sorkin: Does a discrete order underline spacetime and its metric.

Dr. A.A. Tseytlin: Strings and sigma models.

Dr. H. de Vega: Yang-Baxter algebras, integrable theories and quantum groups.

10 VISITORS

As in previous years, visitors from abroad came to the School for short or long periods, for discussions with School's members, to give seminars, and to avail of the School's library resources for their research work. For lectures given by visitors see section 4.1

Short visits (up to one week) were made by :

J. Bell (Geneva) 4-8 Dec.

M. van den Berg (Heriot-Watt) 8-14 Aug.

P. Boulanger (Brussels) 19-22 Dec.

A. Chakrabarti (Paris) 9-13 Oct.

Th. Dorfmuller (Bielefeld) 15-22 Apr.

T.C. Dorlas (Swansea) 10-14 Nov.

J.-L. Gervais (Paris) 24-25 May.

Y.A. Kubyshin (Moscow) 20-26 Nov.

W. McGlinn (Notre-Dame) 2-9 June

D. Petz (Budapest) 25 Feb. - 3 Mar.

L. Schmitt (Osnabrück) 6 - 10 Nov.

N. Sil (India) 11-13 Sept.

C. Stephens (Imperial College) 4-8 Dec.

A. Verbeure (Leuven) 16-21 Mar.

A. Wipf (Munich) 2-9 June.

Longer visits were made by :

D. Buchholz (Hamburg) 30 June - 14 Aug.

N. Duffield (Heidelberg) 12-23 June

M. Fannes (Leuven) 21 Apr. - 23 May

G.W. Ford (Ann Arbor) 5 June - 27 July

G.A.C. Graham (Simon Fraser) 13 Nov. - 21 Dec.

T. Kephart (Nashville) 12-27 Aug.

M. Koca (Turkey) 15-25 Sept.

Z-Q. Ma (Beijing) 20 Apr. - 26 May

R. Musto (Naples) 29 Apr- 3 June

R.F. O'Connell (Baton Rouge) 6-30 June

S. Odinstov (Tomsk) 20 Nov. - 1 Dec.

D.Y. Petrina (Kiev) 19 Nov. - 3 Dec.

C. Pfister(Lausanne) 1 - 31 Mar.

H. Roos (Göttingen) 9 Oct. - 2 Dec.

G. Sabbin (Newfoundland) 21 Sept. - 12 Oct.

G. Savvidy (Yerevan) 23 May - 9 June

A. Sedrakyan (Yerevan) 23 May - 9 June

W.I. Skrypnik (Kiev) 19 Nov. - 3 Dec.

Y. Suhov (Moscow) 10 - 25 Aug., 4 - 15 Sept.

H. de Vega (Paris) 18-29 May

M. Winnink (Groningen) 28 Nov. - 15 Dec.

V.A. Zagrebnov (Moscow) 30 Oct. - 30 Nov.

11 PUBLICATIONS

Note: Items marked with an asterisk have been recorded as in press in previous reports.

11.1 Books

Published

D. O Mathuna: Mechanics, Boundary Layers, and Function Spaces. Birkhauser, 1989.

* B.K.P.Scaife: Principles of Dielectrics. No. 45 Monographs on the Physics and Chemistry of Materials. Clarendon Press, Oxford.

11.2 Communications of the Dublin Institute for Advanced Studies, Series A (Theoretical Physics)

None published.

11.3 Contributions to periodical and other publications

J. Mc Connell:

* Rotational diffusion theory of nuclear magnetic spin-rotational relaxation. *Th. Dorfmuller (ed.), Reactive and flexible molecules on liquids. Kluwer (1989),97-105.*

Schrödinger's nonlinear optics. *Japanese translation by T. Ogawa of Schrödinger Centenary Celebration of a Polymath, ed C.W. Kilmister,pp 146-164, Cambridge Univ. Press(1987).*

A. I. Burshtein, & J. McConnell:

Spectral estimation of finite collision times in liquid solutions. *Physica A* 157(1989) 933-954.

The Poley absorption problem. *J. Molec. Liquids* 43(1989)21-39.

J. T. Lewis:

* Large deviations and statistical mechanics. *Leuven Notes in Math. and Theor. Phys. A.* 1(1989)77-90.

T. Dorlas:

* The statistical mechanics of a Bethe-Ansatz-soluble model. *Proc. 9th. IAMP Congr. on Math. Phys., Swansea 17-28 July 1988.*

T. Dorlas, J.T. Lewis, & J.V. Pulé:

* The Yang-Yang thermodynamic formalism and large deviations. *Commun. Math. Phys.* 124(1989)365-402.

T. Dorlas, & A.C.D. van Enter:

* Non-Gibbsian limit for large-block majority-spin transformations. *J. Stat. Phys.* 55(1989)171-181.

N. Gorman, L. O'Raifeartaigh, & W. McGlinn:

Cartan-preserving automorphisms of twisted and untwisted Kac-Moody algebras. *J. Math. Phys.* 30(1989)1921-1932.

A streamlined highest weight derivation of the bilinear Virasoro centre. *Mod. Phys. Lett. A* 4(1989)1789-1796.

N. Gorman, L. O'Raifeartaigh, D. Williams, & W. McGlinn:

* A unified approach to the computation of central terms in Kac-Moody and Virasoro algebras. *Inter J. Mod. Phys. A.* 4(1989)1235-1255.

D.M. Heffernan, J. O'Gorman, B.J. Hawdon, & J. Hegarty:

* Feedback induced instabilities in external cavity injection lasers. *Electronics. Lett.* 25(1989)114-115.

* Frequency locking and quasiperiodicity in a modulated external cavity injection laser. *J. Appl. Phys.* 66(1989)57-60.
Frequency locking, quasiperiodicity and chaos in modulated external cavity injection lasers. *Coherence and Quantum Optics, ed. J. Eberly, L. Mandel and E. Wolf, Univ. of Rochester Press, 1989.*

D.M. Heffernan, J. O'Gorman, & B.J. Hawdon:

Stability characteristics of nonlinear delay systems. *Nasecode VI, ed. J. Miller, Boole Press, 1989.*

M. Van Den Berg, T.C. Dorlas, J.T. Lewis, & J.V. Pulé:
The pressure in the Huang-Yang-Luttinger model of an interacting boson gas. *Commun. Math. Phys.* 128(1990)231-245

G.A. Raggio, & R.F. Werner:

Minimizing the relative entropy in a face. *Lett. Math. Phys.* 19(1990)7-14.

The Gibbs variational principle for general BCS-type models. *Europhys. Lett.* 9(1989)633-637.

* Quantum statistical mechanics of general mean field systems. *Helv. Phys. Acta* 62(1989)980-1003.

R.F. Werner:

Quantum states with Einstein-Rosen-Podolsky correlations admitting a hidden-variable model. *Phys. Rev.A.* 40(1989)4277-4281.

Remarks on a quantum state extension problem. *Lett. math. Phys.* 19(1990) 319-326.

* Inequalities expressing the Pauli principle for generalized observables. *Leuven Notes in Math. and Theor. Phys. A.* 1(1989)179-196.

* An application of Bell's inequalities to a quantum state extension problem. *Lett. Math. Phys.* 17(1989)359-363.

L.G. Fehér, P.A. Horváthay, & L. O'Raifeartaigh:

Applications of chiral supersymmetry for spin fields in self-dual backgrounds. *Inter. J. Mod. Phys. A* **4**(1989)5277-5285.
Separating the dyon system. *Phys. Rev. D* **40**(1989)666-669.

E. Buffet, & J.V. Pulé:

On Lushnikov's model of gelation. *J. Statistical Phys.* 58(1990)1041-1058.

* Gelation: the diagonal case revisited. *Nonlin.* 2(1989)373-381.

N.G. Duffield, & J.V. Pulé:

* Thermodynamics and phase transitions in the Overhauser model. *J. Stat. Phys.* **54**(1989)449-475.

B.P. Dolan:

The generating function for Ashtekar's canonical transformation in the presence of torsion. *Phys. Lett. B* 233(1989)89-92.

P. Forgács, A. Wipf, J. Balog, L. Fehér, & L. O'Raifeartaigh:

Liouville and Toda theories as conformally reduced WZNW theories. *Phys. Lett. B* **227**(1989)214-220.

J. Balog, & L. O'Raifeartaigh:

* Covariant light-cone algebra. *Nucl. Phys. B* **318**(1989)281-300.

Critical string dimensions as zero curvature conditions. *Proc. XVII Int. Conf. on Differential Geometric Methods in Theor. Physics, Chester,England.(ed. A.I. Solomon, World Sci. 1989).*

J. Balog, P. Forgács, L. O'Raifeartaigh, & A. Wipf:

* Consistency of string propagation on curved spacetimes. An SU(1,1) based counterexample. *Nucl. Phys. B* **325**(1989)225-241.

J. Balog, & M.P. Tuite:

* The failure of Atkin-Lehner symmetry for lattice compactified strings. *Nucl. Phys. B* **319**(1989)387-414.

M. Fannes, B. Nachtergaele, & R.F. Werner:

Exact antiferromagnetic ground states of quantum spin chains. *Europhys. Lett.* **10**(1988)633-637.

D. Petz, G.A. Raggio, & A. Verbeure:

* Asymptotics of Varadhan-type and the Gibbs variational principle. *Commun. Math. Phys.* **121**(1989)217-282.

Z.-Q. Ma, & D.H. Tchrakian:

On the stability of gauge fields in higher dimensions. *Lett. Math. Phys.* **19**(1990)237-243.

G.M. O'Brien, & D.H. Tchrakian:

* Spherically symmetric SO(4) instanton of a non-abelian Higgs model in 4 dimensions. *Mod. Phys. Lett. A.* **4**(1989)1389-1401.

N.G. Duffield, & R. Kuhn:

The thermodynamics of site-random mean-field quantum spin systems. *J. Phys. A.* **22**(1989)4643-4658.

M.A. Vandyck:

* On the problem of space-time symmetries in the theory of supergravity III: Superspace formalism. *GRG* **21**(1989)79-89.

J. Devitt, & P.S. Florides:

* A modified Tolman mass-energy formula. *GRG* **21**(1989)585-612.

B. Goldsmith:

On endomorphism rings of non-separable abelian p-groups. *J. Algebra* **127**(1989)73-79.

R. Göbel, & B. Goldsmith:

* Mixed modules in L. *Rocky Mount. J. Math* **19**(1989)1043-1058.

J.M. Burns, & B. Goldsmith:

Maximal order abelian subgroups of symmetric groups. *Bull. London Math. Soc.* **21**(1989)70-72.

R. Dimitric, & B. Goldsmith:

A note on coslender groups. *Glasnik Mathematicki* **43**(1988)241-246.

P. McGill:

* Some eigenvalue identities for Brownian motion. *Math. Proc. Camb. Phil. Soc.* **105**(1989)587-596.

J.L. Synge:

In honor of Nathan Rosen: Concepts. *Invited article for forthcoming Rosen Festschrift.*

P. Lynch:

The slow equations. Quart. *J. Royal Meteor. Soc.* **115**(1989)201-219.

Partitioning the wind in a limited domain. *Mon. Weather Rev.* **117**(1989)1492-1500.

Allan I. Solomon, A. Montorsi, & M. Rasetti:

The linearized Hubbard model: dynamical superalgebra and supersymmetry. *Inter J. Modern Phys. B.* **2**(1989)247-264.

Self-consistency and supersymmetry in a many-fermion system. *Proc. 16th. Inter. Coll. on Group Theoretical Methods in Physics (Varna, 1987), p154, Springer-Verlag Lecture Notes in Physics 313,1988.* Superalgebraic solution to the mean-field Hubbard model. *Proc. 17th. Inter. Coll. on Group Theoretical Methods in Physics (Montreal, 1988), p277, World Scientific, 1989.*

The Fermi-linearized Hubbard model : Dimer ground state. *Proc. of the NATO Conf. on Interacting Electron Systems (Turin, 1988), Plenum 1989.*

Allan I. Solomon:

Getting on the right terms (Geometry in Physics IV). *Physics Bulletin, October 1989.*

Algebra and superalgebra. *Bull Irish Math. Soc. 22:21(1989).*

W. Kopcsyński, J.D. McCrea, & F.W. Hehl:

The metric and the canonical energy-momentum currents in the Poincaré gauge theory of gravitation. *Phys. Lett. A.* 135(1989)89-91.

F.W. Hehl, J.D. McCrea, E.W. Mielke, & Y. Ne'eman:

Progress in metric-affine gauge theories of gravity with local scale invariance. *Found. Phys.* 19(1989)1075-1100.

E.W. Mielke, F.W. Hehl, & J.D. McCrea:

Belifante type invariance of the Noether identitites in a Riemannian and Weitzenböck spacetime. *Phys. Lett. A.* 140(1989)368-377.

B.K.P. Scaife:

On the Rayleigh dissipation function for dielectric media. *J. Molecular Liquids* 43(1989)107.

M.J. Conneely, & L. Lipsky:

Comprehensive calculations of doubly excited states of 3-electron systems. *Proc. XVI I.C.P.E.A.C.,New York, 1989, ed. A. Dalgarno et al.*

J. M. Golden, & G.A.C. Graham:

A fixed length crack in a sinusoidally loaded general viscoelastic medium. *Continuum Mechanics and its Applications, ed. G.A.C. Graham and S.K. Malik, Hampshire, Washington, D.C. 1989.*

In press

R.F. Werner:

Dilations of symmetric operators shifted by a unitary group. *J. Funct. Anal.*

D.H. Tchrakian, H.J.W. Mueller-Kirsten, & J.-Z Zhang:

Stability of metastability and eigenvalues of the equation of small oscillations. *Inter. J. Mod. Phys.*

J. Balog, L. Fehér, L. O'Raifeartaigh, P. Forgács, & A. Wipf:

Toda theory and W-algebra from a gauged WZNW point of view. *Annals of Physics.*

Allan I. Solomon, & J. Katriel:

Multi-mode, multi-photon coherent states. *Quantum Optics.*

R. Göbel, & B. Goldsmith:

On separable torsion-free modules of countable density character. *J. Algebra.*

J. Burns:

Conjugate loci of totally geodesic submanifolds of symmetric spaces. *Trans. Amer. Math. Soc.*

12 LIBRARY

Approximately 80 new titles were added to the library stock during the year; approximately 200 current periodicals were taken, of which almost half were received by gift or under exchange arrangements. The RIA 'permanent loan collection' was maintained. As in previous years, offprints and preprints were received from many scientific institutes and university departments at home and abroad, either directly or in response to requests. In addition to the regular exchanges and gifts, past and current issues of Edinburgh Mathematical Society Proceedings were received from Prof. Simms and Dr. West.

IV Annual Report of the Governing Board of the School of Cosmic Physics for the Year ended 31 December 1989, adopted at its meeting of 28 June 1990.

1 STAFF, SCHOLARS, ETC.,

Academic Staff

Senior Professors:

Astronomy Section: P.A. Wayman, Director of School

Cosmic Ray Section: L.O'C. Drury

Professors:

A.W.B. Jacob (Officer-in-charge, Geophysics Section), T. Kiang, A. Thompson

Assistant Professors:

D. O'Sullivan, T.P. Ray

Research Assistants:

I. Elliott, P.W. Readman, (1 vacancy)

Experimental Officers:

T.A. Blake, J. Daly, B.D. Jordan

Visiting Scientists:

F.H. Cheng (Hefei), M. Fritzsche (Karlsruhe), A.M. Hillas (Leeds), R. Poetzel (Heidelberg), M. Ritchie (Edinburgh), K. Stammler (Erlangen), N. Tanvir (Durham)

Technical and Clerical Staff:

Astronomy Section: A.M. Callanan, W.M. Dumpleton, M. Smyth

Cosmic Ray Section: G. Broderick, E. Clifton, E. Flood, A. Grace-Casey, S.W. Ledwidge, H. Sullivan, (1 vacancy)

Geophysics Section: K. Bolster, A. Byrne, C.M. Horan, G. Wallace, (1 vacancy)

Scholars:

C.J. Bean (to 15 Sept.), D. Corcoran, M.N. Devaney, P. Duffy, B. O'Reilly

Project Supported Positions:

S. Russell (from 18 Sept.) (ISOPHOT),
H. Walls (from 1 Sept.) (RAPIDS)

Professors Emeriti:

H.A. Brück, T. Murphy, C. O'Ceallaigh

Research Associates:

S. Bleszynski, P.B. Byrne, M. Hoey, N.P. Murphy, W.E.A. Phillips, R.M. Redfern, P.M. Shannon

Vacation Students:

M. Lyons, V. Smith

C.J. Bean was awarded the degree of Ph. D. by Dublin University for his thesis entitled 'A refraction study of the lower lithosphere between Ireland and Northern Britain'.

M.N. Devaney was awarded the degree of Ph. D. by the National University of Ireland (University College, Galway) for his thesis entitled 'Image-sharpening in Astronomy'.

The 10th Anniversary of the signing of the SERC-NBST-DIAS agreement for La Palma was marked by the holding of an exhibition and informal gathering on 1st November. The exhibition was opened by Mr Michael Smith, T.D., Minister for Science and Technology, and among the guests was the Spanish Ambassador to Ireland.

2. RESEARCH WORK (Astronomy and Cosmic Rays)

2.1 Instrument Science

2.1.1 Image-sharpening Methods

R.M. Redfern, UCG, M.N. Devaney, I. Elliott

In a consideration of the theory of atmospheric turbulence, it has been estimated that centroiding of images with short exposures can lead to a gain in resolution of a factor of two. A further gain is possible if image-selection is carried out, provided the aperture used is matched to the seeing, as represented by Fried's parameter. The re-centering and selection will cover fields of size not exceeding 30 arcseconds. Numerical simulations have been carried out to confirm these conclusions. Extensive tests of the methods of focussing and of image-sharpening were carried out using the GHRIL laboratory facility of the Herschel Telescope and equipment modifications were incorporated. In June, the equipment was used on the central stars of planetary nebulae in conjunction with J. Phillips (Queen Mary College, London). During the same period exposures were made on the central regions of the globular cluster M15 and achieved images down to 0.4 arcseconds over a 30 arcsecond field.

In collaboration with J.C. Dainty of Imperial College, London, examination of the possible use of a new detector, PAPA, and storage of data on optical disks (WORM) has begun. Extension of similar equipment as a stellar coronograph is being investigated.

2.1.2 Nuclear Track Detector Response Studies

A. Thompson, D. O'Sullivan, J. Daly with C. Domingo et al (Universitat Autònoma de Barcelona).

Fundamental studies of the track response of polycarbonates to the passage of ultra heavy nuclei continued with emphasis, this year, on short term (less than 100 days) latent track evolution at various temperatures. It was established that no significant evolution occurred in the interval 10 to 100 days after exposure, for temperatures in the region -70°C to +25°C, implying that latent track stability was reached within 10 days. For temperatures above 25°C latent track annealing was observed.

A new set of seventeen independent exposures of detector stacks to relativistic beams of ultra heavy ions (1040 MeV/N gold nuclei and 960 MeV/N uranium nuclei) was carried out during November at the Lawrence Berkeley Laboratory Bevalac in California. The objectives were to investigate (a) the temperature dependance of very short term (less than ten days) latent track evolution using newly assembled polycarbonate stacks and (b) long term (order of years)

evolution by re-exposing existing stacks which have been stored in controlled environments. These two areas of investigation are directly relevant to the planned analysis of Ultra Heavy Cosmic Ray Experiment detector stacks on the LDEF Spacecraft (See Section 2.5.1) which is scheduled for retrieval in early 1990.

2.2 Solar System and Heliosphere

2.2.1 Giotto Mission to Comet Halley

The Energetic Particle Analyser (EPA) Experiment

D. O'Sullivan, A. Thompson with S. McKenna-Lawlor (SPCM) and MPAe, ESTEC

Analysis of the electron and ion data obtained by EPA during the Giotto encounter with Comet Halley has continued. Intensity spikes observed in the inbound particle data, when correlated with magnetic measurements, provide evidence of sporadic field line merging on the sunward side of the comet. Outbound, in addition to a possibility of acceleration due to field line reconnection, indications have been found close to the bow shock that the shock drift process combined with the first-order Fermi mechanism could have been operative in accelerating particles. At distances greater than 10^6 km downstream of the shock, the second-order Fermi effect may be invoked as a contributor to the observed particle energies. Anisotropies in the data recorded at the inbound and outbound bow shocks suggest a preferential escape of particles from the outbound shock. Quasi-periodic variations of cometary ion fluxes observed inbound and outbound by EPA are complementary to energetic particle measurements made aboard the Vega-1 spacecraft and may be attributed to a spin modulation of the outgassing rate of the comet's nucleus.

2.2.2 Phobos Mission

The Solar Low Energy Detector (SLED) Experiment

D. O'Sullivan, A. Thompson, B. Jordan with S. McKenna-Lawlor (SPCM) and MPAe, KFKI, IKI

The second SLED instrument aboard the Phobos-2 spacecraft continued to function normally during the approach to Mars. On 29 January, Phobos-2 was transferred from the Earth-Mars trajectory to an elliptical equatorial orbit of Mars. Four elliptical orbits with a closest approach of about 850 km to the Martian surface, and a period of 79 hours, were completed. After one further intermediate orbit the spacecraft was transferred to a circular orbit with an altitude of approximately 6300 km and a period of 8 hours. Two further modifications were made on 7 March and 15 March, in order to match orbits with the Martian moon Phobos. Then, on 27 March, after 114 circular orbits of Mars had been completed, ground control of the spacecraft was lost. However, the

primary scientific objectives of the SLED experiment, the measurement of energetic electron and ion fluxes in the close environment of Mars, were completed before contact was lost.

The initial results from the SLED experiment were published in the journal Nature during October in a special edition dedicated to the Phobos mission. In particular, ion flux enhancements were observed in the range 30-350 keV in the same general location over eight days at about 900 km altitude in three successive elliptical orbits. Possible interpretations of these observations and those obtained during the circular orbits about Mars are being investigated. Energy related particle shadowing by the body of Mars was also detected.

2.2.3 Giotto Extended Mission (GEM)

The EPA Experiment

A. Thompson, D. O'Sullivan with S. McKenna-Lawlor (SPCM) and MPAe, ESTEC

Necessary activities in support of the proposed new mission (GEM) for the Giotto spacecraft have been authorised by ESA covering a period of check-out for the spacecraft and the payload of on-board experiments. After considering many options the GEM Science Working Team concluded that the best target for the new mission would be Comet Grigg-Skjellerup. Its advantages include a well known orbit, a low dust density and a low fly-by velocity (14 km/sec).

The check-out period will begin on 15 February 1990 when the spacecraft will be at a distance of 1.25×10^6 km from Earth. A final recommendation on the mission will be made by the ESA Science Policy Committee in June 1990. Earth swing-by will occur on 2 July 1990 at a distance of 24000 km from Earth (closest approach). If approved, the encounter with Grigg-Skjellerup will occur on 10 July 1992.

2.3 Stellar Astronomy and Cluster

2.3.1 Jets from Young Stars

T.P. Ray with MPIA, Heidelberg

In collaboration with R. Mundt (MPIA) and others, observational and theoretical work has shown that the HL/XZ Tauri region contains five outflow sources within a region only 0.2 parsecs in diameter. Mutual gravitational disturbances have been invoked to account for the level of activity of this group.

With Poetzel (MPIA) and Mundt, a survey has been undertaken for optical evidence of mass loss from high-luminosity pre-main-sequence objects, in particular Herbig Ae/Be and FU Orionis stars. Of nearly 30 such objects, 10 have been shown to possess jets and/or Herbig-Haro objects. Those with jets include one of the largest systems known, Z CMa, 3.5 pc in size, and several with high (500 km/s) velocities. These jets from high luminosity sources resemble those from young stellar objects (YSO's) as regards Mach numbers, shock velocities, and morphological appearance, but they have larger radial velocities and much higher mass-loss rates.

With Zealey (Wollongong), Williams (Edinburgh), Sandell (JAC) and Taylor (New South Wales), shocked molecular hydrogen in the vicinity of YSO's with optical outflows has been investigated. It was shown that H_2 emission is clumped on the same scale as the optical line emission. Virtually all of the emission was found to be associated with HH objects marking 'working surfaces' of jets. In one case, H_2 emission was found near a jet (the HH1/HH2 system), probably as a result of entrainment.

A proposal in collaboration with Dyson (Manchester), Falle (Leeds), Innes (Heidelberg), Mundt and Raga (Canada), to observe stellar jet formation using the Hubble Space Telescope was accepted as part of the General Observer programme.

2.3.2 Star Formation

L.O'C. Drury, S. Russell and T.P. Ray

A proposal on low mass star formation has been formulated for the Infrared Space Observatory (ISO).

2.3.3 Stellar Flare Statistics

T. Kiang

Discovery of four nearly equally spaced flares in 144 minutes in the binary star YY Geminorum by the group of observers of stellar flare phenomena at Armagh Observatory and their collaborators was the subject of investigation of apparent periodicity occurring in a random series of events. With n + 2 events, a representation by an n-dimensional tetrahedron-analogue showed that the probability of a more regular pattern than an observed pattern could be estimated from a volume specified within such a representation. The results were described at colloquia in Strasbourg and in Ireland.

2.3.4 Ap Stars

I. Elliott, with T. Kreidl et al.

The co-ordinated observing campaign of the Ap star 21 Comae organised from Lowell Observatory, Arizona, was concluded. The campaign involved eleven observers at eight sites over a five-year period and yielded a total of 210 hours of measurements, including 16 hours from the Kapteyn telescope on La Palma. The results indicate that 21 Comae has a double peaked light curve with period 2.00435 days and a peak-to-peak amplitude variation of 0.03 mag. in b, which is attributed to rotation. No evidence for short-period variability was obtained.

2.3.5 Symbiotic Stars

P.A.Wayman

Using the Queen's University Belfast Echelle Spectrograph on the Kapteyn Telescope, the emission line profiles at H-alpha and in other spectrum lines of some ten symbiotic stars were intensively observed over a period of one week in July in order to register potential rapid changes in the profiles corresponding to material movement in the vicinity of the emission areas.

2.4 Interstellar Material

2.4.1 Supernova Remnants

L.O'C. Drury, with MPIK

The work on simplified models for the dynamical evolution of supernova remnants, including the effect of cosmic ray acceleration, was completed and two papers submitted for publication. Work was begun on discussing the plasma physics assumptions inherent in the simplified model approach.

2.4.2 Acceleration Theory

L.O'C. Drury, P. Duffy

Work was begun on a more detailed theory of time-dependent shock acceleration and of the effects of finite curvature of the shock front. The aim is to have a sound analytic theory of test particle acceleration in realistic systems which can be used to calculate the location and approximate shape of the upper cut-off to the accelerated particle spectrum.

With Poetzel (MPIA) and Mundt, a survey has been undertaken for optical evidence of mass loss from high-luminosity pre-main-sequence objects, in particular Herbig Ae/Be and FU Orionis stars. Of nearly 30 such objects, 10 have been shown to possess jets and/or Herbig-Haro objects. Those with jets include one of the largest systems known, Z CMa, 3.5 pc in size, and several with high (500 km/s) velocities. These jets from high luminosity sources resemble those from young stellar objects (YSO's) as regards Mach numbers, shock velocities, and morphological appearance, but they have larger radial velocities and much higher mass-loss rates.

With Zealey (Wollongong), Williams (Edinburgh), Sandell (JAC) and Taylor (New South Wales), shocked molecular hydrogen in the vicinity of YSO's with optical outflows has been investigated. It was shown that H_2 emission is clumped on the same scale as the optical line emission. Virtually all of the emission was found to be associated with HH objects marking 'working surfaces' of jets. In one case, H_2 emission was found near a jet (the HH1/HH2 system), probably as a result of entrainment.

A proposal in collaboration with Dyson (Manchester), Falle (Leeds), Innes (Heidelberg), Mundt and Raga (Canada), to observe stellar jet formation using the Hubble Space Telescope was accepted as part of the General Observer programme.

2.3.2 Star Formation

L.O'C. Drury, S. Russell and T.P. Ray

A proposal on low mass star formation has been formulated for the Infrared Space Observatory (ISO).

2.3.3 Stellar Flare Statistics

T. Kiang

Discovery of four nearly equally spaced flares in 144 minutes in the binary star YY Geminorum by the group of observers of stellar flare phenomena at Armagh Observatory and their collaborators was the subject of investigation of apparent periodicity occurring in a random series of events. With n + 2 events, a representation by an n-dimensional tetrahedron-analogue showed that the probability of a more regular pattern than an observed pattern could be estimated from a volume specified within such a representation. The results were described at colloquia in Strasbourg and in Ireland.

A numerical scheme was developed and implemented to study the acceleration of particles at plane shock fronts in the case where the reaction of the particles on the flow cannot be ignored. The hydrodynamic equations are solved using an explicit Godunov method and the particle transport equation is solved implicitly using a tridiagonal solver. A hierarchical grid in space and time is used to improve the efficiency of the program.

2.5 Cosmological Data

2.5.1 LDEF Mission

The Ultra Heavy Cosmic Ray Experiment (UHCRE)

A. Thompson, D. O'Sullivan, J. Daly with C. Domingo (UAB), K.-P. Wenzel (ESTEC) and V. Domingo (ESTEC)

High levels of solar activity significantly increased the LDEF orbit decay rate, which reached 0.8 km per day by the end of the year. The current best estimate for re-entry into the Earth's atmosphere is 8 March 1990 and the estimated critical deadline date, beyond which LDEF retrieval would be impossible (240 km altitude limit), is 28 February 1990. The current (31 December 1989) LDEF altitude is 320 km. The latest space shuttle manifest schedules LDEF retrieval during a ten day mission by Colombia (STS-32) with launch on 8 January 1990. The extended exposure time of the UHCRE detector stacks (5.8 years) will result in a greatly enhanced yield of cosmic ray data. In particular it is expected that the world's first statistically significant sample of actinide nuclei will be obtained.

2.5.2 Magellanic Cloud Abundances

S. Russell

With Dopita (Mount Stromlo & Siding Spring Observatories) the first consistent abundance analysis of both HII regions and supernova remnants in the Magellanic Clouds were obtained from detailed modelling of medium resolution spectra extending from 300 to 1100 nm. It was found that there was essentially no zero point error between the low mass abundance scale from the HII regions and the high mass scale of the supergiants. It was suspected from the data that element abundances relative to iron in the Clouds are more closely related to our local interstellar medium (ISM) than to the sun itself. If this is the case, the sun must have formed in a different environment from that in which it is now situated.

A further detailed investigation, concerning the heavier elements in the Magellanic Clouds, reveals that the s-process has been as effective there as in the local ISM up to atomic number 40 in the SMC and up 56 in the LMC. For higher

Z than these, the pattern of abundances is, however, consistent with a purely r-process origin, and inconsistent with any contribution from the s-process.

2.5.3 ELISA Proposal

L.O'C. Drury and A. Thompson

A consortium of scientists from thirteen European research centres, headed by DIAS, prepared a proposal to the European Space Agency for the next medium scale mission (M2); the final editing and printing of the proposal was carried out in Dublin. Named ELISA (European Large Ionization Spectrometer for Astrophysics), the proposal is to launch a large (40 tonne) calorimeter surrounded by position-sensitive charge-determining modules into Earth orbit, using the heavy launch capabilities of the Soviet Union in a co-operative ESA/IKI mission. This experiment would determine charge-resolved energy spectra in the mysterious "knee" region of the spectrum (10^{15}–10^{16}eV) and make a fundamental contribution to cosmic ray studies. It could also open a new window in gamma ray astronomy by carrying out an all-sky survey for gamma rays in the region 10^{11}–10^{13}eV, several decades of energy higher than any other currently planned mission.

2.5.4 The Horizon Problem

T. Kiang

A start has been made to construct more informative and more precise diagrams for illustrating the horizon problem in cosmology. The range of reference is widened from a single event, the emission of the microwave background, to the entire set of all observed events at present, and the unspecified axes in a well-known diagram of light cones are identified.

3. RESEARCH WORK (Geophysics)

3.1 Gravity

T. Murphy, P.W. Readman with staff of Hamburg, Plymouth and Galway.

Preparation of the 1:126,720 scale series of gravity maps continued. T. Murphy reviewed the onshore gravity and magnetic fields in a paper given at the Workshop in Galway on the Deep Geology and Geophysics of Ireland and its Continental Margin at the end of October.

P. Readman, with Hamburg co-authors, presented the COOLE/HOGS offshore gravity map at the same Workshop. Geological models for two profiles were

derived: (i) from Donegal Bay into the Rockall Trough and (ii) along an EW line at 52.3 N through an elongated closed gravity low. Profile (i) was consistent with the RAPIDS seismic structure and indicated that the margin is in overall isostatic equilibrium. The low off Co. Clare was modelled as a deep sedimentary basin (10 km) but there is, as yet, no seismic data to confirm this result.

P. Readman worked with M. Ford and C. Brown on an analysis and tectonic interpretation of gravity data over the Variscides of South West Ireland. The results were presented at the Galway Workshop.

3.2 Meteorology

K. Bolster

Limited measurements continue to be carried out at Leinster Lawn and on the roof of 5 Merrion Square on weekdays, with readings for other days being taken from the hydrograph, thermograph and rain recorder. Readings are given once a week to the Meteorological Service by telephone and monthly returns of temperatures and rainfall are made on standard forms. Archival and current records remain available to interested enquirers, students, etc.

3.3 **Seismic Work**

3.3.1 The Seismic Network

K. Bolster, C.M. Horan, A.W.B. Jacob, G. Wallace

Two of the stations are now closed, DDK and DKM. The closure is not necessarily permanent as the existing DNET stations (DLE, DCN, DMU) and the ENET stations (ECP, ECB, ETA) are in different geological environments and work best when treated separately. As three stations is the minimum number required for reasonable source location, there is no redundancy in the data provided by either group. One or two extra stations would be advantageous.

There was only one small earth tremor in Ireland in 1989. This occurred between Enniscorthy and New Ross on 28 July. The Irish Sea was less active than in 1988. In March the Piper Alpha platform wreckage was demolished in the North Sea and in April a large Second World War mine was destroyed in the Firth of Clyde. Both were recorded and provided signals from known positions. Notable overseas events included a very large rock-burst in an East German mine in March (magnitude 5.7), the largest event of the year near the Macquaire Islands, south of Australia (magnitude 8.0) and the destructive earthquake on 18 October in northern California, with a magnitude of 7.0.

M. Ritchie (BGS, Edinburgh) visited the Geophysics Section in December and a joint study of the Irish Sea events has been initiated. There is now enough data collected to make an evaluation of the source mechanisms worthwhile. Data from both the British and Irish networks will be used.

3.3.2 Celtic Onshore-Offshore Lithospheric Experiment - COOLE

B.M. O'Reilly, A.W.B. Jacob, P.M. Shannon

The North Celtic Sea Basin interpretation work was continued. The thermal and rheological properties of the earth's lithosphere are important in determining its response to extensional deformation associated with plate tectonic movements. Models which predict the rheological properties of the crust, based on measured heat flow data, have been developed. These imply a relationship between the thermal and rheological structure of the lithosphere which can further be related to the age, thickness and mean P-wave velocity of the crust and the onset of reflectivity in the lower crust. Computer modelling has proved successful in explaining the gross seismic structure of the North Celtic Sea Basin. The regional implications of the model are more speculative.

3.3.3 Lower Lithospheric Studies and ILIHA (Iberian Experiment)

C.J. Bean, A.W.B. Jacob, T.A. Blake, K. Bolster, C.M. Horan, G. Wallace

Further developments in this work were described in papers given at the EGS meeting in Barcelona in March and at the Galway Workshop in October. The models, and the mechanisms by which they are derived, explain the observations well. The ILIHA project, which is part of the European Geostraverse, was carried out in September/October 1989 and was specifically designed to study the lithosphere under a cratonic unit which moved substantially during the opening of the Bay of Biscay. It is thus likely that lower lithospheric features, like those observed elsewhere, will be found and will provide a test for the DIAS models.

The Geophysics Section brought 20 seismic stations to Spain. The four staff who travelled with them operated four field groups, each with 5 stations and one Spanish student to assist with the deployment and language problems. The equipment worked very well and, from that point of view, the experiment was a useful preliminary run before the Kenyan experiment (due to take place early in 1990). Due to problems experienced by the Spanish Navy, not all the seismic shots were fired. Preliminary evaluation of the data gathered so far should be complete by the autumn of 1990.

3.3.4 Seismic Project in Kenya - KRISP

A.W.B. Jacob, C.M. Horan, G. Wallace

The Research permit for KRISP was issued in June 1989 and the fieldwork for the seismic refraction part rescheduled for January/February 1990. B. Jacob took part in a number of detailed planning meetings in the summer and early autumn. He also took part in seismic source trials in Kenya in September. G. Wallace and C. Horan further developed and shock-proofed the DIAS seismic equipment. Very high temperatures and rough treatment were to be expected in Kenya. The equipment was flown from Frankfurt to Nairobi in December as part of a large KRISP consignment. Equipment from many other sources, including the US Geological Survey, also arrived in Kenya in December.

3.3.5 GEOTWIN

A.W.B. Jacob, C.J. Bean, T.A. Blake with University of Karlsruhe

The main progress in this project arose from visits by K. Stammler and M. Fritzsche. A Seismic Handler for the display and analysis of seismic data was set up by K. Stammler on the Vaxstation 2000. This achieved one of our main targets in GEOTWIN and provided a system into which existing programs could be incorporated. M. Fritsche helped to implement a program for generating synthetic seismic sections for anisotropic structures.

3.3.6 RAPIDS - Seismic Profile West from Ireland

A.W.B. Jacob, P.M. Shannon, C.J. Bean, T.A. Blake, K. Bolster, C.M. Horan, H. Walls, with University of Hamburg

The data were very quickly digitized in Hamburg during January and February. Preliminary interpretation was carried out in early January in DIAS. This was followed by more detailed work in both Hamburg and DIAS in the late spring and early summer. As the model developed, data and interpretations were presented at the Joly Colloquium in April, at the European Association of Exploration Geophysicists (EAEG) Meeting in Berlin at the end of May, and at the Galway Workshop in October. Two papers on the preliminary results and interpretation have been submitted for publication.

Interesting results from RAPIDS include:

(i) The Rockall Trough is underlain by continental crust, albeit significantly thinned, along the RAPIDS line. This crustal continuity extends to the Hatton Bank and some, as yet, undetermined distance beyond.

(ii) The Rockall Trough contains approximately 5 km of sediment and the southern Hatton-Rockall Basin some 3 km. Preliminary analysis suggests the presence of Tertiary and older sediments. These display lateral variations and interesting fault-related structures are detected in the data.

The success of RAPIDS has led to a new RAPIDS-2 project which is due to take place in the summer of 1990. The RAPIDS-1 line will be extended over the western margin of the southern Hatton Bank and an axial line will be run along the centre of the Rockall Trough from just north of the RAPIDS-1 line towards the mouth of the Trough to the south.

3.3.7 QUASH - A reflection seismic programme using quarry blasts

T.A. Blake, A.W.B. Jacob with other Geophysics staff and the University of Karlsruhe.

Deep P-wave reflections from the base of the crust and below the Moho have been widely observed. S-wave reflections from such depths are unusual and very expensive to obtain. It has been observed on DNET, and in the project which studied the North Dublin Basin, that modern quarries are very strong generators of S-waves and relatively weak sources of P-waves. The QUASH experiment used refraction equipment and a reflection spread with three-component seismometers to record the seismic waves from quarries at Huntstown and near Slane. Full treatment of the data must await digitization of the analogue recordings but preliminary indications are that energy has been returned at times compatible with both P and S reflections from the base of the crust.

3.4 Palaeomagnetism

P.W. Readman with N. Abrahamsen, Aarhus

(a) Lake Sediments

Analysis of results from Denmark has continued and the Record obtained from Lake Sorø finalised and published. A detailed comparison with data from the UK highlights the problems of dating lake sediments accurately and indicates the need for more data before a definitive geomagnetic secular variation curve for NW Europe during the Post Glacial period is obtained.

(b) Cave Sediments

The results of palaeomagnetic and mineral magnetic measurements on sediment from Ball's Cave, near Schoharie, N.Y., U.S.A. were analysed. It was found that the geomagnetic variations recorded in the two sediment sequences could be correlated with other North American records back to 13000 B.P. and, more tentatively, between 23000 - 30000 B.P. The results show that cave sediments can, under the correct conditions, record the secular variation of the geomagnetic field. Detailed magnetic and Mössbauer measurements showed that the dominant magnetic mineral is fine grained magnetite.

4 WORKSHOPS

4.1 Queen's University Belfast Echelle Spectrograph

B.D. Jordan, P.B. Byrne

A project undertaken in 1988 and 1989 was to provide automatic operation of QUBES, the Queen's University echelle spectrograph, to make it suitable as a common-user instrument on the 1-m Kapteyn telescope on La Palma. Provision for motor control of several mechanical movements was provided. Preliminary tests were carried out on La Palma in July 1988; improvements were effected early in 1989 including replacing the solenoid action by a stepper motor. Material for a technical manual was provided. The completed instrument was delivered to Queen's University in May and the instrument was shipped to La Palma in July.

4.2 Transputer Development

B.D. Jordan, I. Elliott

An improved version of the Spanish IPD Transputer interface was completed and was in use at the GHRIL during 1989. Differential drive amplifiers for the Transputer links were completed and tested. A complete instrument enclosure was provided, including a prototype focus monitor designed at UCG. The equipment included interconnection to the telescope control room over a cable length of 100 m. The equipment was tested at the GHRIL facility of the Herschel Telescope on La Palma in April and used again in June.

4.3 Servo Motor Drive

B.D. Jordan

In conjunction with the engineering section of the Royal Greenwich Observatory, a general purpose DC servo motor controller and drive system has been designed. The system has an immediate application to the polarimeter of the ISIS spectrograph on the Herschel Telescope on La Palma. The system is based on the existing RGO 6303 microcomputer and will be provided with a control program of sufficient flexibility to enable it to be configured for a variety of applications. Up to four 45-watt DC servomotors may be controlled and driven via a multiplexer. The motors would incorporate 12-bit incremental encoders giving potential positional shaft accuracy of 0.1 degrees. A FORTH development system is included in the RGO equipment; the programming and the construction is due for completion in September 1990.

4.4 Geophysics Instruments

G.A. Wallace

Network stations continued to require considerable maintenance. The equipment, being more than ten years old, has been in continuous use under field conditions. Development work has mainly involved the mobile seismic stations. There is now an accurate internal clock, in addition to the radio channel, which is encoded and recorded with the radio and flutter channels. The battery charging system for the 20 field sets has been improved and, as regards portability, it is worth noting that four stations, plus playback and supporting equipment have been carried as personal baggage in three suitcases to the United States.

4.5 Solid State Nuclear Track Detector Processing Facilities

J. Daly

A third 150 litre etching unit for solid state nuclear track detectors was constructed during the year. This unit, in common with the two units previously built, features temperature stability continuously controlled to ± 0.015°C at 40°C and temperature uniformity throughout its active volume within ± 0.01°C. The two earlier units were overhauled and completely refurbished.

5 COMPUTER INSTALLATIONS

5.1 At 5 Merrion Square

T.A. Blake, T.P. Ray

The hardware warranty on the Microvax II ceased and a new maintenance contract was negotiated. Support for the Vaxstation 2000 was also placed. Hardware installed during the year included a Nimbus AX/2 computer, a Quattro PC clone for word processing, and an associated Brother laser printer. A Smartwriter laser printer was implemented on the MicroVax and a digitising table and graphics screen were purchased secondhand. TCP/IP software was installed for communication between the Vax and the Sun workstation. A new revision of Chiwriter was installed on all IBM PC clones. Disaster recovery, with particular reference to the remaining Data General systems, was reviewed.

Arising from an application to Eolas by T.P. Ray, P.A. Wayman and L. Drury, entitled 'A National Data Analysis Facility for La Palma and the Hubble Space Telescope', a Sun SPARC Station has been installed, capable of rapid handling of observational data including that provided by the Hubble Space Telescope. T. Ray has installed the Munich Image Data Analysis System (MIDAS).

5.2 At Dunsink Observatory

I. Elliott, B.D. Jordan

A fourth Tandon PC/AT with VGA and 30 MB disk was purchased, providing allocation of two instruments for transputer applications and two for general use or for further adaptation. Options for transfer of observational data to WORM laser disks has been investigated using a standard SCSI interface to Transputer modules. Transfer rates of 850 kB/s to double-sided laser disks with a capacity of 470 MB per side is envisaged. This application may make the selection of data at the telescope, in order to make magnetic tape storage less onerous, unnecessary.

The 3L version of Parallel Fortran for INMOS Transputers was purchased and implemented. Mathematical routines were put into Fortran library form.

The data link to UCD operated reliably during the year and the Starlink Software Collection was updated to Version 372 in July. Use of a Kermit terminal emulator mode on the Tandon computers gives access to the UCD Vax system.

6 HISTORY OF ASTRONOMY

6.1 Grubbs of Dublin

P.A. Wayman

Collection of material relevant to the history of the instrument makers Thomas and Howard Grubb revealed the existence of some eighty photographic negatives dating from c. 1859, produced by the waxed paper process and attributable to Thomas Grubb. These negatives were in first class condition and represent an unique collection.

The historical antecedants, from Denmark and N. Germany, to the Grubbs of Ireland were traced by other material as far back as the tenth century A.D.

6.2 Telescope by Alvan Clark

I. Elliott

The erstwhile existence in Ireland of an important 19 cm. lens made by Alvan Clark and used by W.R. Dawes, W. Erck and W.H.S. Monck, has been traced as far as possible but the lens itself, which was regarded as one of Clark's best small lenses, having been used by Erck in Ireland to verify the discovery of the Mars satellites Phobos and Deimos, appears to have been lost. Literature references have been collated for inclusion in a Clark monograph by D.J. Warner of the Smithsonian Institution.

7 LA PALMA OBSERVATORY

7.1 General

Membership of the Advisory Committee for the La Palma Project remained unchanged during 1989. The committee met twice and provided reports to the Governing Board, including recommendations on the allocation of travel funds for observing work. It was unable to allocate any funds for the period March to August 1990 (Semester R), due to a current high level of allocation.

Professor B. McBreen (UCD) has been appointed to the U.K. Panel for Allocation of Telescope Time and will act as observer for Ireland at most meetings of that Panel. Dr R.M. Redfern has joined the GHRIL (Groundbased High Resolution Imaging Laboratory) Instrument Committee; he continues as a member of the La Palma Users Committee and the GHRIL Users Committee.

Dr Charles Jenkins and Mr Michael Morris, both of the Royal Greenwich Observatory visited Dublin in February for discussion of matters of mutual interest in the area of instrumentation for La Palma.

7.2 La Palma Visits, 1989

Visits for observing and instrumental work on La Palma were made as follows:

R. Ekins (UCD) and S. Plunkett (UCD), JKT, 8-16 January

R.M. Redfern (UCG), N. Devaney and P. O'Kane (UCG), WHT, 24-27 April

R.M. Redfern (UCG), N. Devaney and P. O'Kane (UCG), WHT, 23-25 June

B.D. Jordan, for commissioning QUBES on the JKT, 9-16 July

P.A. Wayman, JKT, 21-27 July

R. Ekins (UCD) and S. Plunkett (UCD), JKT, 28 Dec. - 5 January 1990

8 SEMINARS, COLLOQUIA, LECTURES

8.1 Statutory Public Lecture

The Statutory Public Lecture of the School was given on November 1 in University College, Dublin, by Professor P.A. Wayman on 'The La Palma Observatory'.

8.2 Seminars in the School

The following seminars were presented on Institute premises during the year:

13 January	Prof. Kakurri (Finland), 'Gravity Measurements in Finland'.
31 January	F. H. Cheng (Hefei, China), 'The uv Spectra of Quasars'
17 February	C. Jenkins and M Morris (RGO), 'Planning for Facilities at the La Palma observatory'.
1 May	B. Espey (IoA, Cambridge), 'IR Spectroscopy of Quasars'
15 May	S. Biswas (Tata Institute, Bombay), 'Partially Ionised Heavy Low Energy Cosmic Rays'
29 May	M.K. Wallis (Cardiff), 'Structure of the Outer Heliosphere'

22 December M.N. Devaney, 'Application of a modified Wiener Filter to photon-resolved images' (A contribution to the December Mathematical Symposium of the School of Theoretical Physics).

8.3 External Lectures

P.A. Wayman and L. Drury contributed to Maths Course 444 for Senior and Junior Sophister students at Trinity College, Dublin, during the Hilary Term on 'Topics in Stellar Physics' and 'The Interstellar Medium' respectively.

I. Elliott gave a course of 16 lectures on 'Introductory Astrophysics' to Junior Sophister students in honours physics in Trinity College in the Michelmas Term and eight lectures in the Hilary Term.

T.P. Ray delivered a course of lectures on Plasma Astrophysics to final year Physics students at Trinity College during the Hilary Term.

I. Elliott gave a course of ten lectures on 'Astronomy Today' to extra-mural students in U.C.D., Spring 1989.

D. O'Sullivan presented a series of eight lectures on Cosmic Rays to sophister students at Trinity College Dublin.

D. O'Sullivan presented a talk on the DIAS-ESTEC experiment at the NASA LDEF meeting in Williamsburg, Virginia.

B.M. O'Reilly, with A.W.B. Jacob and P.M. Shannon, presented a paper 'Seismic studies of the crust in the North Celtic Sea Basin - structural implications', at the U.K. Geophysical Assembly at Egham, Surrey, 29-31 March.

C.J. Bean and A.W.B. Jacob presented a paper 'Seismic evidence for large-scale decoupling in the lower lithosphere' at the European Geophysical Society meeting, Barcelona, 13-17 March.

T.P. Ray, with J. Dyson (Manchester), organised a one-day 'Specialist Meeting' of the Royal Astronomical Society in London on 12 May on the topic 'Outflows from Young Stars'. Ray delivered a review paper on stellar jets at the Santa Cruz Workshop on star formation and similar papers were presented to the Low Mass Star Formation Workshop of the European Southern Observatory at Garching, FRG.

B.M. O'Reilly spoke on 'Seismic studies of the North Celtic Sea Basin' at the Irish Geological Association Annual Meeting at Belfast, 25-26 February.

A.W.B. Jacob gave an invited lecture on 'Anisotropy in the lower lithosphere' to the Geophysics Institute of ETH, Zurich, on 8 June. At a 'Lough Beltra' Workshop at Galway, 5 - 6 April, he spoke on the RAPIDS project and members of the Geophysics Section presented six papers, and joined in two others, at a Workshop in Galway, 28 - 30 October, on 'Deep Geology and Geophysics of Ireland and its Continental Margin'.

L.O'C. Drury spoke on 'ELISA - a proposal for a very large cosmic ray space experiment' at the MPI f. Aeronomie, Lindau, on 17 July, on 'Cosmic Ray production in supernova remnants' at MPI f. Astrophysik, Munich, on 10 August, and on 'Teilchen Beschleunigung und die dynamische Entwicklung von SN-Überresten at the Astronomische Institute, Bonn, on 13 October.

P.A. Wayman attended the General Congress of the International Union for the History and Philosophy of Science in Hamburg and Munich, 1 - 9 August, and spoke on 'Phase and power requirements for electrical pendulum and clock control'. He also spoke on 'Thomas Grubb, telescope maker and banknote printer' at a Symposium on the History of Technology, Science and Society, at the University of Ulster, Jordanstown, 11 - 14 September.

A.W.B. Jacob and J. Makris (Hamburg) gave invited papers on 'Seismic structure on-shore and off-shore Ireland' at the Joly Colloquium, TCD, 25 April. At the European Association of Exploration Geophysicists in Berlin on 29 May, J. Makris presented a joint paper with C.J. Bean, A.W.B. Jacob, T. Liebe, P.M. Shannon and A. Ginsberg, 'Off-shore seismic studies West of Ireland'.

T. Kiang spoke on the occurrence of apparent periodic behaviour under random sampling of events at an International Colloquium on 'Errors, Bias and Uncertainties in Astronomy' in Strasbourg, France, 11 - 14 September.

S. Russell presented a paper on the proposal for low mass star formation observations at a meeting of the ISO-photometer (ISOPHOT) consortium held in Heidelberg, 25 - 26 September.

B.M. O'Reilly spoke at the UCD Geology Department on 'Seismic refraction and kinematic models' on 14 January.

A.W.B. Jacob spoke on 'Seismic refraction methods' at UCD on 1 February.

P.A. Wayman spoke on 'Astronomical Time' at the Physical Society, NIHE, Dublin on 27 February, and addressed the Limerick Autumn meeting at Birr, Co. Offaly, on 23 September on 'Hipparcos - How and Why'.

I. Elliott gave two lectures as part of an in-service course for science teachers at the Dept. of Education, UCD, on 23 June, and a lecture to secondary teachers on the Earth's environment at Carlow RTC on 21 October, as part of a meeting Science - an Historical Approach', organised by the Institute of Physics and the Irish Science Teachers' Association.

The following seven contributions were made at meetings of the Irish Astronomical Science Group at Dundalk on 23 March and at D.I.A.S., 10 Burlington Road, on 18 September:

Dundalk:

M.N. Devaney: 'The New Sandage Atlas of Galaxies and the Cosmological Distance Scale'

L.O'C. Drury: 'Cosmic Ray Production in Supernova remnants

P. Duffy: 'Cosmic Rays above 10^{15} eV'

P.A. Wayman: 'Modern Time Scales'

Dublin (DIAS):

P. Duffy: 'Second-order Fermi acceleration of pick-up ions'

T. Kiang: 'Are those flares periodic?'

P.A. Wayman: 'The La Palma Observatory, Retrospect and Prospect'

The following eight contributions were made at the workshop entitled 'Deep Geology and Geophysics of Ireland and its Continental Margin', Galway, 28—29 October, sponsored by the Royal Irish Academy and the Geological Society of London:

C.J. Bean, A.W.B. Jacob, B. Nolte and C. Prodehl:

'Has the lower lithosphere a role in controlling large-scale surface deformations?'

A.W.B. Jacob with J. Makris, R. Egloff, T. Leibe and P. Mohr:
'The crust under the southern Porcupine Seabight: seismic and gravity profiles'

A.W.B. Jacob, P.M. Shannon, J. Makris, A. Ginsberg, T. Leibe and C.J. Bean:

'The extension of the continental crust west from Ireland: the RAPIDS 1988 profile'

C. Lowe, A.W.B. Jacob, C. Prodehl and A. Ruthardt:

'Seismic refraction surveys and onshore crustal structure of Ireland'

T. Murphy:

'The gravity and magnetic fields in Ireland'

B. O'Reilly, J. Makris, P.M. Shannon, and U. Vogt:

'The seismic structure of the North Celtic Sea Basin: implications for basin development'

P. Readman with M. Ford and C. Brown:

'An analysis and tectonic interpretation of gravity data over the Variscides of S.W. Ireland'

P.W. Readman, K. Gohl, T. Leibe and J. Makris:

'Marine gravity surveys west of Ireland'

8.4 The Cosmic Ray Conference 1991

The Institute has invited the Cosmic Ray Commission of the International Union for Pure and Applied Physics to hold the 1991 International Cosmic Ray Conference in Dublin. A Local Organising Committee has been set up under the chairmanship of Professor N.A. Porter, with D. O'Sullivan, Cosmic Ray Section, as Secretary. The conference will be held in Trinity College Dublin from August 11th to August 23rd and is expected to attract over 600 delegates from more than 30 countries. Arrangements for the conference are at an advanced stage.

8.5 Popular Astronomy

P.A. Wayman demonstrated the Zeiss Planetarium of the West Cork Vocational School, Schull, at the formal opening by President Hillery on 9 March.

Talks were given to the Irish Astronomical Society by L. O'C. Drury on 20 February on 'Cosmic Rays and Astronomy' and by P.A. Wayman on 10 April on 'Supernova 1987A updated'.

I. Elliott contributed two talks, 'Our place in the Universe' and 'Chaos in the Cosmos' at a week-end meeting of the West Cork Astronomical Society, 11 - 12 December.

The South Telescope at Dunsink Observatory, with associated talks given in the Meridian Room, formed the customary Public Open Night programme on fourteen nights during the year. Visiting groups on other occasions included the Royal Aeronautical Society (Irish Branch), the Society for Gifted Children, the Burma Star Association, the Royal Dublin Society Youth Science and Arts Week, and the UCD Extra-Mural Class in Astronomy.

9 EXTERNAL WORK

The following working visits to other institutions and conferences were undertaken during the year (see also 7.2 and 8.3 above):

Astronomy Section:

I Elliott	Parallel Processing Workshop, Southampton, 11-12 December.
B. D. Jordan	Satellite Tracking Ground Station, Yav Patoria, USSR, 28 January - 5 February. RGO Herstmonceux, 18 - 21 September.
T. Kiang and F. H. Cheng	R. Astronomical Society, London, 13 January.
R. M. Redfern	GHRIL meeting, RGO, 6 - 7 March. La Palma Users Committee, London, 9 May. La Palma Users Committee, Leiden, 5 November.
P. A. Wayman	SPIE Optical Instrument Conference, Paris, 25 - 26 April. University of Sussex, Brighton and R. Astronomical Society, 11-12 May. University of Cardiff, 7 July and Panel for Allocation of Telescope Time, Bristol, 11 - 12 July. Space Telescope European Coordinating Facility, Garching, 30 - 31 October.

Cosmic Ray Section:

L.O'C. Drury	ISOPHOT Consortium, Heidelberg, 18 - 22 March. MPIK, Heidelberg; MPAe, Lindau; MPA, Garching, 10 June - 23 August. ELISA Consortium Meetings, Paris, 25 - 26 October, London, 2 June; 7 July; 8 September and 8 November. ISOPHOT meeting, Heidelberg, 23 - 27 September. Bonn; Heidelberg, 12 - 17 October.
P. Duffy	Chapman Workshop, Guildford, UK, 17 - 21 July
D.O'Sullivan	SLED, IKI, Moscow, 30th January - 9th February. LDEF, Williamsburg, Virginia, 20 - 28 May. International Symposium on Phobos, Paris, 21 - 26 October. GSI Darmstadt, ion accelerator facilities, 21 November and Phobos data, MPAe, 22 - 26 November. Institute of Physics meetings at Bristol, 18th October; Belfast, 22nd April; 11th November and Ballina, 18th - 19th March.

T. P. Ray	Panel for Allocation of Telescope Time, Swindon, 12 - 13 January. Heidelberg, 14 - 21 January. EADN meeting, Ponte de Lima, Portugal, 14-15 September. Space Telescope European Coordinating Facility, Garching, 30 - 31 October.
S. Russell	AAT Symposium, Manchester, 27 September. ISO programme meeting, Elmau, FRG, 4 - 8 November.
A. Thompson	Giotto/Gem, ESOC, Darmstadt and MPIK, Heidelberg, 18 - 20 February. LDEF, Williamsburg, USA, 20 - 28 May. ELISA Consortium Meetings, London, 2 June; 7 July; 8 September and 8 November. EPS, Eindhoven, 28 - 29 June. ELISA meeting, ESA HQ, Paris, 25 - 26 October. GEM, ESOC and GSI, heavy ion facilities, Darmstadt, 12 - 15 December.

Geophysics Section:

C.J. Bean	RAPIDS processing, Hamburg, 10-31 January; 8-26 February; 12-16 June.
T.A. Blake	RAPIDS visit, Hamburg, Erlangen Karlsruhe, 13 February - 1 March. UKGA, London, DECUS, Exeter, 28 March - 7 April. ILIHA Project, Spain, 26 September - 25 October. EC, Brussels, 13 - 14 November.
K. Bolster	ILIHA Project, Spain, 26 September - 22 October.
C. M. Horan	RAPIDS processing in Hamburg, 10 - 31 January. ILIHA Project, Spain, 22 September - 22 October.
A. W. B. Jacob	RAPIDS visits to Hamburg, 9-14 February; 10-11 May. EGT Workshop, Karlsruhe, 27 February - 4 March. EC visits, 23-24 April; 17-19 May; 13-14 November. GEOTWIN visit, Karlsruhe, 9 - 15 June. ILIHA project, Spain, 17-18 June; 26 September - 2 October. KRISP, FRG, 16-18 August; 17-19 October; 8-10 November and 28 November - 6 December; Kenya, 7 - 26 September.
T. Murphy	UKGA, London, 28 March - 1 April. Galway Workshop, 28 - 29 October.

B.M.O'Reilly	Galway Workshop, 28 - 29 October.
P.W. Readman	HOGS/COOLE visits to Hamburg, 12 June - 18 July and 20 November - 9 December. SW Ireland gravity work at UCG, 17 - 19 April. Galway Workshop, 28 - 29 October. UKGA, London, 28 March - 1 April.
G. Wallace	ILIHA Project, Spain, 22 September - 25 October. KRISP project, FRG, 28 November - 6 December.

10 PUBLICATIONS

10.1 Geophysical Bulletins

P. Morris:

'A composite magnetic map of Ireland', Geophys. Bull. No. 42, 1989.

T. Murphy:

'Gravity anomaly map 1:126720 Scale, Sheet 13 MEATH', Geophys. Bull. No. 38, 1989.

10.2 Journals

L.O'C. Drury, W.J. Markiewicz and H.J. Völk:

'Simplified models for the evolution of supernova remnants including particle acceleration,' Astron. Astrophys., 225, 179—191, 1989.

T. Kiang:

'Some numerical aspects in a search for $I = 1$ periodic orbits for Hecuba asteroids', Celestial Mechanics, **45**: 55-60, 1989.

T. Kiang:

'A simplification in the calculation of the characteristic exponents of the plane circular model of three bodies', Celestial Mechanics, **46**:, 79-84, 1989.

C.P. Lowe and A.W.B. Jacob:

'A north-south seismic profile across the Caledonian Suture zone in Ireland', Tectonophysics, **168**: 297-318, 1989.

B.M. O'Reilly, A.W.B. Jacob and P.M. Shannon:

'Seismic studies of the crust in the North Celtic Sea Basin - structural implications', Geophys. Journ., 96: 587, 1989.

D. O'Sullivan and A. Thompson with V. Afonin, S. McKenna-Lawlor, K. Gringauz, K. Kecskemety, E. Keppler, E. Kirsch, A. Richter, A. Somogyi, A. Varga and M. Witte:

'Energetic Ions in the Close Environment of Mars and Particle Shadowing by the Planet', Nature, **341** : 616-618, 1989

D. O'Sullivan and A. Thompson with E. Kirsch, S. McKenna-Lawlor, P. Daly, A. Korth, F.M. Neubauer and K.-P. Wenzel:

'Evidence for the field line reconnection process in the particle and magnetic field measurements obtained during the Giotto-Halley encounter', Annales Geophysicae, **7** : 107-114, 1989

D. O'Sullivan and A. Thompson with S. McKenna-Lawlor, P. Daly, E. Kirsch, B. Wilken, K. Kecskemety, A. Somogyi and A. Coates:

'In Situ Energetic Particle Observations at Comet Halley recorded by Instruments aboard the Giotto and Vega-1 Missions', Annales Geophysicae, **7** : 121-128, 1989

T.P. Ray with R. Poetzel and R. Mundt:

'Z CMa: a large-scale high velocity bipolar outflow traced by Herbig-Haro objects and a jet', Astron. Astrophys., **224**: L13, 1989.

T.P. Ray with W.J. Zealey, R. Mundt, G. Sandell, T. Geballe, K.N.R. Taylor, P.M. Williams and H. Zinnecker:

'Stellar Outflows and Jets', Proc. Astr. Soc. of Australia, 8: 62, 1989.

R.M. Redfern, M.N. Devaney, P. O'Kane, E. Ballasteros Ramirez, R. Gomez Renasco and F. Rosa:

'Image-sharpening of time-tagged counts from a photon counting detector: application of a modified Wiener filter', Mon. Not. R. Astr. Soc., 238:, 791, 1989.

S.C. Russell and M.S. Bessell:

'Abundances of The Heavy Elements In The Magellanic Clouds I Metal Abundances of F-Type Supergiants', Ap. J. Supplement, **70**: 865, 1989.

A. Thompson and D. O'Sullivan with E. Kirsch, S. McKenna-Lawlor, W.-H. Ip, P.W. Daly and F.M. Neubauer:

'A Correlation of Energetic Particle Flux Anisotropies with Magnetic Field Variations inside and outside the Coma of Comet Halley', Adv. Space Res., **9** : 3343-3346, 1989

A. Thompson and D. O'Sullivan with S. McKenna-Lawlor, E. Kirsch, P. Daly, A. Somogyi and K. Kecskemety:

'A Comparison of quasi-periodicity in the Ion Flux Enhancements recorded inbound and outbound at Halley's Comet by the EPONA instrument aboard Giotto and by the Tunde-M instrument aboard Vega-1', Adv. Space Res., **9** : 3325-3330, 1989

P.A. Wayman and C.A. Murray:

'Relativistic light deflections', The Observatory, **109**: 189-190, 1989.

10.3 Conference Proceedings

T.P. Ray with J. Eislöffel and R. Mundt:

'Proper motion measurements of the jets from young stars - first results', Astr. Ges. Abstr., Ser.3, 35, 1989.

T.P. Ray with R. Mundt, T. Buhrke, J. Solf and A. Raga:

'Optical jets and outflows in the HL Tau region', Astr. Ges. Abstr., Ser.3, 34, 1989.

T. P. Ray with R. Poetzel and R. Mundt:

'High velocity optical outflows and jets from luminous young stars', Astr. Ges. Abstr., Ser.3, 34, 1989.

10.4 Irish Astronomical Journal

Following financial and publication problems, which delayed the production of vol. 18, no.4 (September 1988), resulting in three issues being reported in this year instead of the normal two, a new format was adopted from vol.19 no.1 onwards, using TeX production of camera-ready sheets of improved appearance.

The following contributions are included in vol.18, no.4, and vol.19, nos. 1 2.

Vol.18 (September 1988):

p.248 T.P. Ray, R. Mundt and T. Bührke: 'Multiple jets in the HL Tau region'.

p.249 P.A. Wayman: 'The gas shells of RS Puppis'.

p.271 T. Kiang: 'An attempt to determine the stability of $I = 1$ periodic orbits in the circular model of three bodies'.

p.272 (Notice on 1983Nk = (3751)Kiang; naming of a Minor Planet)

Vol.19 (March and September 1989):

p.4 R.M. Redfern: 'High resolution imaging on La Palma'.

p.11 I. Elliott: 'The Universe as a teaching aid'.

p.30 P.A. Wayman: 'Astronomy at the School of Cosmic Physics in 1987'.

p.37 I. Elliott: 'New uses for Schmidt plates' and 'The discovery of Neptune'.

p.40 P.A. Wayman: 'James Lick's monument, by Helen Wright' (review)

p.41 P. A. Wayman: 'The Astronomical Scrapbook, by Joseph Ashbrook' (review) and 'The Invisible Universe Revealed, by G.L. Verschuur' (review)

p.42 I. Elliott: 'Breakthroughs - A chronology of great achievements in science and mathematics 1200-1300, by C.L.Parkinson' (review) and 'Microcomputer control of telescopes, by M.Trueblood and Russell Genet' (review).

p.43 P.A. Wayman: 'Nearby Galaxies Atlas, by R.B. Tully and J.R. Fisher', (review).

p.44 I. Elliott: 'The Sky - A graphic astronomy program for the IBM PC and compatibles, by Stephen Bisque' (review).

p.54 L.O'C. Drury, et al: 'Simplified models for the evolution of supernova remnants modified by particle acceleration'.

p.55 N. Devaney: 'The Sandage and Bedke Atlas of Galaxies and the cosmological distance scale'.

p.56	P.A. Wayman:	'Modern time scales'.
p.64	P. Duffy:	'Cosmic rays above 10^{15} eV'.
p.89	I. Elliott:	'A link with Japan'.
p.90	I. Elliott:	'The monthly sky guide, by I. Ridpath and W.Tirion' (review).
p.95	I. Elliott:	'How far away are the stars? - Discovering astronomy, by Peppo Gavazzi' (review).
p.95	P.A. Wayman:	'The Peripatetic Astronomer, by H.A. & M.T. Brück and Eye on the Sky, by D.E. Osterbrock, et. al.' (review).
p.98	P.A. Wayman:	'Supernova 1987A in the Large Magellanic Cloud, Ed. by M. Kafateos and A. Michalitsanos' (review).
p.99	L. Drury:	'Supernova remnants and the Interstellar Medium, IAU Coll. 101, Ed. by R.S. Roger and T.L. Landeker' (review).

11 MISCELLANEOUS

D. O'Sullivan has been appointed Secretary of the Irish Branch of the Institute of Physics.

A. Thompson and D. O'Sullivan were appointed members of the European Space Agency's GEM Science Working Team.

D. O'Sullivan and A. Thompson were appointed members of the NASA LDEF Ionizing Radiation Special Investigation Group (IRSIG).

A. Thompson continued as Secretary of the National Committee for Physics.

D. O'Sullivan continued as review editor for the journal 'Nuclear Tracks and Radiation Measurements', and as secretary of the Local Organizing Committee for the 22nd International Cosmic Ray Conference (see 8.4). He was appointed to the International Committee for the 15th International Conference on Particle Tracks in Solids which will be held in Marburg, Germany, in September 1990.

T.P. Ray has continued as Secretary of the Astronomical Science Group of Ireland (ASGI) and as an editor for the Irish Astronomical Journal.

P.W. Readman acted as co-editor of a special volume of Physics of the Earth and Planetary Interiors on 'Palaeomagnetism and the evolution of the Tethys'.

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

FINANCIAL STATEMENTS FOR YEAR ENDED 31 DECEMBER 1989

CONTENTS

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

1989

GENERAL

The Institute was established under the Institute for Advanced Studies Act, 1940.

Its functions include the provision of facilities for the furtherance of advanced studies and the conduct of research in specialised branches of knowledge.

It comprises three Schools - Celtic Studies, Theoretical Physics and Cosmic Physics.

ACCOUNTING POLICIES

1. Accounting basis:

The Accounts have been prepared under the historical cost convention.

2. Oireachtas and Lottery Grants:

Income shown in the Accounts under these headings is the actual cash received in the period of the Account and includes £19,000 for increases in remuneration.

3. Fixed Assets:

Fixed Assets comprise the furniture and equipment of the Institute and are shown at cost less accumulated depreciation.

The rate of depreciation is 10% per annum calculated on a straight line basis.

Premises occupied by the Institute are leased from the Office of Public Works.

4. Capital Reserve:

The capital reserve comprises income allocated for the purchase of fixed assets. It is written down in line with the depreciation of the related assets.

5. Library:

Expenditure on library books and materials is charged to the Income and Expenditure Account. The current value of such books and materials is estimated at £470,000.

6. Publications:

Expenditure on publications is written off in the year in which it is incurred. The estimated value of such publications on hand at 31 December 1989 was £683,598.

7. Superannuation:

Salaries are charged net of pension contributions. Expenditure arising under the Institute's superannuation schemes is met out of Oireachtas Grants in the year of payment. No provision has been made in these accounts for future superannuation commitments.

Income and Expenditure Account
for the year ended 31 December 1989

1988		1989
£		£
	INCOME	
1,317,000	Oireachtas Grant	1,325,000
605,000	Lottery Grant	517,000
37,847	Sales of Publications	46,505
---	Theoretical Physics Workshop Fees	3,900
191,253	School of Cosmic Physics (Note 4)	205,816
41,079	Miscellaneous (Note 9)	46,561
2,192,179		2,144,782
91,499	Transfer to Capital Account (Note 6)	4,145
2,100,680		2,140,637
	EXPENDITURE	
503,272	School of Celtic Studies	404,464
264,786	School of Theoretical Physics	285,924
836,148	School of Cosmic Physics	885,561
459,642	Administration	494,816
68,323	Depreciation (Note 5)	69,700
2,132,171		2,140,465
(31,491)	**SURPLUS (DEFICIT)** for year	172
445,566	Balance at 1 January	414,075
414,075	Balance at 31 December	414,247

The Accounting Policies, Notes 1 to 9 and Statement 1 form part of these accounts.

M. L. Whitaker

CHAIRMAN - COUNCIL OF THE INSTITUTE

Balance Sheet at 31 December 1989

1988				1989
£	£		£	£
384,968		Fixed Assets (Note 5)		389,113
		Current Assets:		
	350,884	Cash on hands and at Bank	385,524	
519,723	168,839	Debtors and prepayments	208,970	594,494
904,691		TOTAL ASSETS		983,607
		Current Liabilities:		
	83,508	Creditors and Accruals (Note 2)	156,722	
105,648	22,140	Funds (Note 1)	23,525	180,247
799,043		Net Assets		803,360
		Financed by:		
414,075		Surplus-Income and Expenditure Account		414,247
384,968		Capital Reserve (Note 6)		389,113
799,043				803,360

The Accounting Policies, Notes 1 to 9 and Statement 1 form part of these accounts.

M. K. Whitaker

CHAIRMAN - COUNCIL OF THE INSTITUTE

Statement of Source and Application of Funds
for the year ended 31 December 1989

	£
Source of Funds:	
Surplus for the year	172
Adjustment for items not involving the movement of funds:	
Transfer to Capital Account	4,145
Depreciation	69,700
	74,017
Application of Funds:	
Purchase of Fixed Assets	73,845
	172
Increase/(Decrease) in Working Capital:	
Increase in Debtors & Prepayments	40,131
Increase in Creditors & Accruals	(73,214)
Increase in Funds	(1,385)
Increase in Cash on hands & at Bank	34,640
	172

Statement 1

Detailed Analysis of Income and Expenditure for the year ended 31 December 1989

	School of Celtic Studies	School of Theoretical Physics	School of Cosmic Physics	Administration	Total	1988 Total
INCOME	£	£	£	£	£	£
Oireachtas Grants	1,000	265,500	753,400	305,100	1,325,000	1,317,000
Lottery Grant	367,000	-	-	150,000	517,000	605,000
Sales of Publications	46,083	26	396	-	46,505	37,847
Theoretical Physics Workshop Fees	-	3,900	-	-	3,900	-
School of Cosmic Physics (Note 4)	-	-	205,816	-	205,816	191,253
Miscellaneous (Note 9)	5,155	998	930	39,478	46,561	41,079
	419,238	270,424	960,542	494,578	2,144,782	2,192,179
Transfer to Capital Account:						
Allocated for Capital purposes	(12,833)	-	(45,887)	(15,125)	(73,845)	(160,124)
Amount released on disposals					-	302
Amortisation in line with asset depreciation					69,700	68,323
					2,140,637	2,100,680
EXPENDITURE						
Salaries, Wages and Superannuation (Note 8)	258,223	168,221	557,103	252,589	1,236,136	1,399,493
Scholarships	38,753	51,319	21,242	-	111,314	91,807
Honoraria	250	-	250	-	500	1,493
Library	15,370	27,619	22,546	-	65,535	60,676
Microfilms	629	-	-	-	629	247
Publications	55,706	2,356	2,344	1,396	61,802	33,445
General Administration (Note 3)	-	-	-	206,024	206,024	208,995
Travel and Survey Expenses	8,200	9,187	31,159	1,168	49,714	52,366
Workshop '89 Symposia & Seminar Expenses	450	13,836	-	-	14,286	1,058
Equipment: Consumable & Mainteranance	-	-	33,102	-	33,102	36,874
Special Commitments and Projects	-	-	194,676	-	194,676	97,407
General Expenses	26,883	13,386	23,139	33,639	97,047	79,987
	404,464	285,924	885,561	494,816	2,070,765	2,063,848
Depreciation (Note 5)					69,700	68,323
					2,140,465	2,132,171
SURPLUS (DEFICIT) FOR YEAR	1,941	(15,500)	29,094	(15,363)	172	(31,491)
Balance at 1 January 1989	157,487	28,968	76,912	150,708	414,075	445,566
Balance at 31 December 1989	159,428	13,468	106,006	135,345	414,247	414,075

NOTES TO THE ACCOUNTS

1. Funds:

		£
These comprise:	Vernam Hull Bequest	22,251
	Carmody Fund	1,274
		23,525

The funds are held on deposit.

2. Creditors and Accruals:

Included in this heading is £30,869 contract research monies unexpended at 31 December, 1989, which is credited to revenue in line with expenditure on projects (Note 4).

3. General Administration Expenses:

Rent, Rates & Insurance	83,631
Premises Maintenance	41,692
Postage & Telephones	45,227
Fuel, Light & Power	28,368
Sundry Supplies	7,106
	206,024

4. School of Cosmic Physics - Research Programmes and Fees:

Project	Contributor	Opening Balance	Income	Applied	Unexpended
		£	£	£	£
Seismic Survey at Carnsore	ESB	-	300	300	-
Geotwin	EEC	-	4,130	3,436	694
EGT	EEC & ESF	-	2,355	2,355	-
HOGS	Dept. Energy/ Oil Industry	2,324	-	870	1,454
BGS	Br. Geol. Surv	-	3,403	3,403	-
KRISP	EEC	-	14,086	14,086	-
ISOPHOT	ESA	-	16,848	16,848	-
ILIHA	EEC	7,445	10,140	17,585	-
RAPIDS	Depts. Energy & Industry & Commerce Hamburg Univ.	758	146,342	118,566	28,534
Cosmic Ray Conf. 1991	Bórd Fáilte	500	-	313	187
La Palma Obs.	Dept. Ind & Commerce	-	6,500	6,500	-
Astronomical Data Facility	Dept. Ind & Commerce	-	21,000	21,000	-
Other Fees & Contributors	Various	-	554	554	-
		11,027	225,658	205,816	30,869

NOTES TO THE ACCOUNTS (Contd.)

5. **Fixed Assets** (Furniture & Equipment):

	£
Cost at 1 January, 1989	824,324
Additions	73,845
Cost at 31 December, 1989	898,169
Accumulated Depreciation at 1 January, 1989	439,356
Depreciation in year	69,700
Accumulated Depreciation at 31 December, 1989	509,056
Net book value at 31 December, 1989	389,113
Net book value at 31 December, 1988	384,968

6. **Capital Reserve**:

	£	£
Balance at 1 January, 1989		384,968
Transfer from Income and Expenditure Account		
Income allocated for capital purposes	73,845	
Amortisation in line with asset depreciation	(69,700)	4,145
Balance at 31 December, 1989		389,113

7. **Leasing**:

(a) Operating Leases:

The premises occupied by the Institute are leased from the Office of Public Works. The commitment on foot of such leases in respect of 1990 is £39,800. All except £260 of this commitment is on foot of leases of property from year-to-year.

(b) Finance Leases:

There were no appreciable finance leases in existence at 31 December, 1989.

8. **Superannuation**:

The total superannuation payments in the year amounted to £197,455. The salaries and superannuation charge in the accounts is net of contributions totalling £19,669.

9. **Miscellaneous**:

Included in Miscellaneous is Bank Interest earned of £39,329 (1988 - £33,531) for the year.

Institiuid Ard-Leinn Bhaile Atha Cliath

Report of the Comptroller and Auditor General

I have examined in accordance with Auditing Standards the Accounts set out on Pages 1 to 9 which are in the form approved under the provisions of Acht um Institiúid Ard-Leinn, 1940. I have obtained all the information and explanations which I considered necessary for the purpose of my audit.

In my opinion proper books of account have been kept by An Institiúid and the Accounts, which are in agreement with them, give a true and fair view of the state of its affairs at 31 December 1989, and of its transactions and source and application of funds for the year then ended.

P. L. McDonnell

Comptroller and Auditor General

19 December 1990